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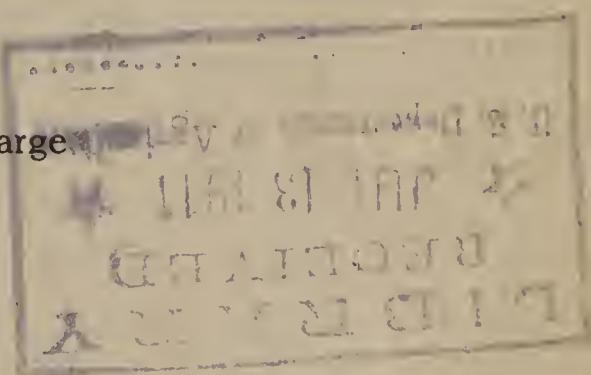
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THE

## GRAZING INDUSTRY

BY

E. V. WILCOX,  
Special Agent in Charge



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Paradise of the Pacific Print  
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# THE GRAZING INDUSTRY

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## INTRODUCTION.

Of the 4,000,000 acres in the Territory about 1,600,000 acres are used for grazing. The grazing lands are thus of relatively large importance in area. Moreover the quantity and quality of live stock are advancing with the advance in prices of meat and other animal products, and with the demands for better quality of meat. In the early days of the live stock industry animals brought such low prices as to preclude the possibility of expending money economically in the improvement of ranches and of the breeds of live stock. All these conditions have changed. The demand is now for better quality, and more attention must be given to the importation of fine sires. Then too the increase of population makes additional demands for animal products. More beef, mutton, pork and other products are needed. The grazing lands are, therefore, assuming a greater importance than ever before. This brings about the necessity of using grazing lands more economically, and of making them produce to the fullest extent.

The utilization of the immense areas of grazing lands on the mainland has taught some valuable lessons during the past century. It is believed that these lessons are of importance in the best utilization of the grazing lands of the Territory. A comparison has therefore been made between the past and present condition of the grazing lands of the range States. In this comparison all available literature has been searched to gain an idea of the original condition of forage on the range, with special consideration of the various factors which have had an influence on the condition of range grasses, and on the preservation of the range. The statements regarding the early conditions are compared directly with what is known as to the present state of the range. The writer has traveled over all of the western States in investigating the range industry. The problems met by western ranchmen are essentially the same as those which present them-

selves to the ranchers of the Territory, and the application of the experience of the western States can readily be made by the individual rancher.

As in the western States so in this Territory the importance of the forest cover of certain lands must be considered. Then there are the dangers of overgrazing, the relative values of various grasses, the need of improving the range by the introduction of new grasses and the wider use of known species, and the necessity of raising more forage crops to supplement the natural range and to produce a better quality of meat. The grass cover of the range must be carefully considered, for in Hawaii the dangers from erosion by wind, and surface evaporation are greater than in any State on the mainland. Fortunately there are no predacious wild animals in Hawaii, and sheep, therefore, do not have to be herded. This fact increases the carrying capacity of the range lands, for sheep in open formation and allowed to graze at will do not injure the range so much as when they are closely herded.

The recent great improvement in the range industry of Hawaii is sufficient evidence of the progressiveness of the ranchers. It is believed that the following discussion of the western ranges from a historical standpoint will bring out several points of interest to the ranchers of Hawaii.

#### **HISTORICAL SKETCH OF THE PUBLIC DOMAIN.**

The public domain, exclusive of our insular possessions, originally embraced all of the United States west of Georgia, North Carolina, Kentucky, West Virginia, and Pennsylvania. The area of this tract was 1,855,780,427 acres. The title of the Government of the United States to this land was acquired through cession by States, purchase, treaty, conquest and settlement.

The greater portion of the territory east of the Mississippi and outside of the thirteen original States was claimed by these States on the basis of grants from Great Britain. The States thus concerned ceded this land to the general Government at various dates between 1781 and 1802. The total area of State cessions was 259,171,787 acres.

On April 30, 1803, the Louisiana purchase was made by treaty with France. This territory embraced the present States of Louisiana, Arkansas, Missouri, Iowa, Nebraska, North and South Dakota, Indian Territory, and parts of Kansas, Minnesota, Montana, Wyoming, and Colorado. The area thus added to the public domain amounted to 565,166,080 acres and cost \$15,000,000.

By treaty with Spain, February 22, 1819, Florida was purchased for \$5,000,000. This purchase increased the public domain by 44,639,360 acres.

On June 15, 1846, the Oregon boundary question was finally settled by treaty with England. The "Oregon country" embraced all of Washington, Oregon, and Idaho, and those parts of Montana and Wyoming which lie west of the continental divide. The total area of this region was 191,795,200 acres. This country was not included in the Louisiana Purchase. Our claims to it as enumerated by Ross of the Oregon Boundary Commission of 1824 were as follows: Discovery by Gray in 1792; exploration by Lewis and Clark in 1805; Astoria settlement in 1811; and Florida treaty of 1819. By this treaty Spain gave up all claim which she may have held regarding the Northwest coast. Oregon was actually prevented from falling into the hands of the English and was saved for the United States by American settlers, aided and encouraged by Marcus Whitman, Fremont, Senator Benton, Hall J. Kelley, Wyeth, and others.\*

A treaty with Mexico February 2, 1848, secured to the United States California, Nevada, Utah, and parts of Colorado, Arizona, and New Mexico. This territory embraced 334,443,520 acres and cost \$15,000,000. By the Gadsden purchase December 30, 1853, the Mesilla Valley in Arizona and New Mexico was added to the public domain. This tract of 29,142,400 acres cost \$10,000,000.

The State of Texas, when admitted into the Union, retained control of its lands. The National domain was thus greatly increased without any addition to the public domain. The

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\* Marcus Whitman and the Early Days of Oregon, by W. A. Mowry, and The Louisiana Purchase, by Binger Hermann.

United States, however, on September 9, 1850, purchased from Texas 61,892,480 acres at a cost of \$16,000,000. This area embraced parts of Kansas, Colorado, New Mexico, and the "public land strip."

Alaska with an area of 369,529,600 acres was purchased from Russia March 30, 1869, for \$7,200,000. For various reasons, however, Alaska is omitted from the present discussion of the public lands. On account of the reservations of North Carolina with regard to land claims in Tennessee the general Government relinquished all claim to public land in the latter State. The actual public domain with which we have to deal in the present discussion embraced therefore about 1,455,000,000 acres.

Congress has absolute control of the public lands and may pass any needful regulations regarding their protection and utilization until they are disposed of. Although the governmental ownership of the public lands was complete, the idea of making these lands comparable with the crown lands of Great Britain was apparently never entertained. As soon as title was obtained Congress began to dispose of the public lands to private individuals and corporations.

The first plan for the disposal of the public lands was proposed by Alexander Hamilton, Secretary of the Treasury, in 1790. His report to the House of Representatives contained the following suggestions:

"That in the formation of a plan for the disposition of the vacant lands of the United States there appear to be two leading objects of consideration; one, the facility of advantageous sales, according to the probable course of purchases; the other, the accommodation of individuals now inhabiting the western country, or who may hereafter emigrate thither. The former, as an operation of finance, claims primary attention; the latter is important as it relates to the satisfaction of the inhabitants of the western country. . . . Purchasers may be contemplated in three classes; moneyed individuals and companies who will buy to sell again; associations of persons who intend to make settlements themselves; single persons or families. . . . .

"A plan for the sale of the Western lands, while it may have due regard for the last, should be calculated to obtain all the advantages which may be derived from the two first classes."

Hamilton accordingly recommended that the lands be sold in any quantities without limit and that convenient tracts be set aside for location by settlers in quantities not to exceed 100

acres to each person. Hamilton thus clearly foresaw the three chief sources from which have come demands for the public lands, viz.: land speculators, settlement colonies, and homesteaders.

During the first years of its existence the Government of the United States needed money and the public lands were naturally looked to as an important source of revenue. In 1795 a law was passed turning the proceeds from the sales of public lands into a sinking fund for the redemption of the public debt. In 1796 Congress provided for the sale of lands in Ohio in sections and quarter townships at \$2 per acre. In 1800 a unit of 320 acres east of the Muskingum and 640 acres west of that river was established, together with the system of disposition through registers. The same act provided for the leasing of the public domain in sections or half sections for a term not exceeding seven years. Certain lands were offered for sale in tracts of 160 acres. In 1820 Congress provided for the sale of 80-acre lots of land at a minimum price of \$1.25 per acre, with a "double minimum" of \$2.50. The various prices at which land was sold between 1785 and 1880 were 12 1-2, 25, 50, 66 2-3, and 75 cents and \$1.00, \$1.25, and \$2.50 per acre.

Between 1801 and 1841 sixteen preemption acts were passed. The fundamental idea contained in these acts was to give settlers preference over land speculators. This system in its final form gave settlers the right to occupy public land in areas of not more than 160 nor less than 40 acres, for a certain period at the end of which they were required to pay \$1.25 per acre for the land. While according to the Preemption Act a premium was set upon actual settlement, yet title to the land could not be acquired except by purchase. The Preemption Act is thus clearly distinguished from the Homestead Act, according to which final title to the land can be obtained merely from a residence of five years. The idea of holding the public lands for revenue thus gave place to that of devoting them to the encouragement of settlement. The agitation for free homes for settlers, however, did not assume a definite shape until the formulation of the platform of the Free Soil Democracy in 1852, the 12th plank of which read as follows: "That the public lands of

the United States belong to the people, and should not be sold to individuals nor granted to corporations, but should be held as a sacred trust for the benefit of the people and should be granted in limited quantities, free of cost, to landless settlers."

This proposition was kept constantly before the public until, in 1862, the Homestead law was enacted. The idea of free homes was thus realized. The Homestead law made possible the acquisition of complete title to 160 acres of land by a residence of five years upon the selected location. A commutation clause was subsequently added according to which the settler, at the end of six months' residence on his claim, could at once secure title by the payment of \$1.25 per acre.

The Timber Culture Act, passed in 1873 and amended in 1874, enabled settlers to acquire title to 160 acres of land on condition of growing a certain amount of timber. In 1875 an act was passed permitting the sale of desert lands in California in areas of 640 acres at the rate of \$1.25 per acre. The "Desert Land Act" was passed in 1877 and made to apply to the Dakotas, Montana, Idaho, Washington, Oregon, California, Wyoming, Utah, Nevada, Arizona, and New Mexico. The unit of sale was 640 acres and the settler was allowed three years in which to get water on the land. Under this act the land cost \$1.25 per acre but residence was not necessary.

By utilizing the Preemption, Homestead, Timber Culture, and Desert Land Acts it was possible for one person to secure title to 1,120 acres of land; but the Desert Land unit was later reduced to 320 acres and in 1891 the Preemption and Timber Culture acts were repealed.

In addition to the agricultural acts mentioned above, various other methods of disposal have been adopted from time to time. In this way immense areas of the public lands have passed out of the control of the Federal Government. From a total of about 1,455,060,000 acres of actual public domain more than 155,000,000 acres were granted to railroads to assist in construction, 66,076,550 acres were given as bounties for military and naval service and 190,000,000 acres were donated to the States for the support of schools, land grant colleges, and other purposes. The total amount of public domain

disposed of from its origin to 1883 was about 620,000,000 acres and since that date the disposal has ranged between 8,000,-000 and 27,000,000 acres per annum. The present area of the unappropriated public domain in the public land States and Territories is about 400,000,000 acres, lying almost entirely west of the Mississippi and Missouri and in the arid or semi-arid region. The following discussion deals with the characteristics and utilization of this remaining area of public lands.

### **GENERAL DESCRIPTION OF THE PRESENT PUBLIC LANDS.**

*Topography.* The public lands which are still vacant lie almost entirely west of the 100th meridian. This area may be conveniently subdivided into a number of large regions fairly well defined by climate and physical features. For present purposes the following regions will be recognized, viz; Great Plains, Rocky Mountain Region, Great Basin, Southwest, and Pacific Coast.

The Great Plains may be considered as including all territory between the 100th meridian and the foothills of the Rocky Mountains. The western portion of North and South Dakota, Nebraska, Kansas, and Oklahoma, and the eastern portion of Montana, Wyoming, and Colorado lie in this region. In general the Great Plains is a comparatively level tract, gradually increasing in altitude toward the west. The northwestern part of the area slopes northward while the remainder slopes southeastward. The chief agricultural industry of the Great Plains is grazing. Dry farming is possible over large areas, but successful farming without irrigation depends upon an average rain fall. In dry years crops fail or make very poor yields. The practical difficulties of obtaining water for irrigation from the Missouri, Platte, Kansas, and Arkansas rivers are so great that little can be expected from this source for years to come. Irrigation agriculture on the Great Plains is at present largely confined to the valleys of small streams and areas watered by the use of windmills, pumps, or artesian wells. The thorough utilization of these means, however, will undoubtedly lead to much greater development of the agricultural resources of this

region. The soils are rich and the grazing excellent. The grazing capacities of the range are not fully utilized at present on account of lack of water at convenient intervals. The number of livestock can be considerably increased as soon as more water is obtained by artesian wells or otherwise.

*Characteristics.* Except on the eastern border of the Great Plains the average rainfall is less than 20 inches. At Dodge, Kansas, the average precipitation for the years 1875-1898 inclusive, was 20.38 inches. Great variation, however, was noticed during this period, ranging from 11 to 33 inches. While a rainfall of 33 inches is quite adequate for farming purposes a precipitation of 11 inches is insufficient. The rainfall of the Great Plains is advantageously distributed inasmuch as the largest monthly precipitation occurs from May to July. The summer rains, however, are of an erratic character. They are likely to be of too great violence and to occur at irregular intervals with intervening periods of drouth. The central portion of the Great Plains is more subject to violent rains than the northern part, where the precipitation, although somewhat less, is gentle and of longer duration. As summarized by W. D. Johnson\* the chief climatic disadvantages of the central portion of this region are violent summer rains, considerable annual variation in amount of rainfall, high normal summer temperature, relatively low humidity, prevalence of drying winds and consequent high rate of evaporation. These deficiencies of climate are, however, of much less weight in stockraising than in other agricultural operations, and stock growing can be much extended by creating an artificial supply of drinking water for the stock.

The Great Basin includes nearly the whole State of Nevada and parts of California, Utah, Wyoming, and Oregon. As a natural drainage area it is distinguished by the fact that no water flows from it into the sea. The total area of this region is about 217,000 square miles. The chief rivers of Nevada are the Carson, Humbolt, Truckee, and Walker. Their waters are lost in the soil, by evaporation or in marshy lakes. The other

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\* The High Plains and Their Utilization, U. S. G. S. 21st Rpt., Part IV., p. 678.

important rivers of the Great Basin lie in Utah and are the Jordan, Bear, Ogden, Weber, Provo, Sevier. The ground rises from about sea level in the southwest corner of the Great Basin to an altitude of 5,000 feet in central Nevada, and that is about the general level of the region. North of the Humboldt the altitude is greater, while some valleys, like that of the Great Salt Lake, are lower. There are certain depressions, notably Death Valley, below the level of the sea. There is considerable uniformity in the general appearance of the Great Basin. The country is interrupted at frequent intervals by short mountain ranges of volcanic origin, their average height above the general level being from 1,000 to 4,000 feet. Most of the streams and lakes become dry every year.

The total area under irrigation in Nevada is about 505,000 acres, while in that part of Utah which lies in the Great Basin nearly 564,000 acres are irrigated. The drainage areas are comparatively small and quite independent. There are several exceedingly barren areas called deserts. The most important of these are Great Salt Lake, Carson, Mojave, Colorado, Escalante, Sevier, Amargosa, and Ralston deserts.

The annual precipitation of the Great Basin varies from 6 inches in some of the most arid valleys of Nevada to 30 or 40 inches on the bordering mountains. At Salt Lake City the annual rainfall ranges from 10 to 28 inches. Throughout the Great Basin dry farming is of limited extent and grazing must constitute the chief agricultural industry of the region. The further extension of irrigation in the Great Basin seems to depend largely on the construction of suitable reservoirs. In the well-watered parts of Utah, however, the Mormons have developed a highly perfected system of irrigation.

The term "Southwest" is here used to include New Mexico, Arizona, and southern California. This region is characterized by its semitropical climate and great aridity. The soils are fertile except where alkali prevails. In the lower valleys tropical fruits may be raised with good success, while on the higher bench lands and foothills conditions are found for the cultivation of the crops of temperate climates.

This region is drained by four large rivers, the Pecos, Rio

Grande, Gila, and Colorado, with their numerous tributaries. The northern part of Arizona has an altitude of about 6,000 feet. The surface is irregular and the rivers run in deep canyons. The agricultural possibilities are therefore not so great as in the southern part of the territory. From an agricultural standpoint the most important valley of southern Arizona is that of Salt River. In southern California all available water from the surface and from wells is utilized in the production of a great profusion of citrus and other semitropical fruits as well as other crops. The productiveness of the soil is very great, and land values and water rates correspondingly high.

New Mexico exhibits a gradual slope from an altitude of 7,000 feet on the north to 3,500 on the south. The general direction of the mountains, valleys, and streams is from north to south. The annual precipitation ranges in different parts of the Territory from 2 to 24 inches and the mean annual temperature from 48° to 61° F. The grazing grounds of the Southwest extend from the high valleys and mesas to an altitude of 10,000 feet. The raising of sheep has been found to be particularly profitable on account of the favorable climatic and grazing conditions. The waters of the Rio Grande, Pecos, and Canadian are utilized almost to their fullest extent for irrigation but the extensive construction of artesian wells has added greatly to the irrigated area.

The Rocky Mountain Region may be taken as including Idaho, the western part of Montana, Wyoming, and Colorado, and the eastern part of Utah, Oregon, and Washington. The region as a whole consists of high valleys and basins of various sizes interrupted by mountain ranges. The general level is comparatively high, the valleys being from 3,000 to 7,000 feet and mountains from 8,000 to 13,000 feet in altitude. The dome of the region is in northwestern Wyoming from which the country slopes in all directions and from which flow the sources of the chief rivers of the West, viz; Missouri, Yellowstone, Colorado, and Columbia.

In general this region may be said to be abundantly watered. Numerous small streams from springs or melting snow furnish a perennial supply of water for irrigation. In some localities

the supply has been fully utilized for irrigation while in others there are large quantities still unappropriated. The annual precipitation in the valleys and basins is usually under 20 inches, while on the high mountains it is much greater. This is particularly true for central Colorado, eastern Utah, northern Idaho, and northwestern Montana.

The soils of the valleys and basins are deep and highly productive except in alkali regions. In some valleys the rich soil extends downward to a depth of 50 to 75 feet without any pronounced change. On such soils and on the foot hills and lower mountain slopes crops obtain moisture by capillary action and seepage, and dry farming has yielded satisfactory results. Within the limits of this region the following areas are under irrigation: In Colorado, 1,600,000 acres; in Utah, 66,000 acres; in Wyoming, 600,000 acres; in Montana, 950,000 acres; in Idaho, 600,000 acres; in Oregon, 380,000 acres; and in Washington, 135,000 acres.

The chief crops of this region are wheat, barley, oats, alfalfa, and other forage crops, sugar beets, and other root crops, together with the various hardy orchard and small fruits. As in other parts of the arid region, however, grazing is the most important agricultural industry. The ranges of the Rocky Mountain States are subject to more severe winter weather and deeper snowfall than in the Great Basin or Southwest. The native forage, however, is superior in quality and quantity and the range has not suffered to the same extent from evergrazing. The ranges of the Southwest and Great Basin furnish perhaps the best breeding grounds for stock, while the Great Plains and the Rocky Mountain Region furnish the best grazing.

The Pacific Coast Region as used in this connection includes northern California and western Oregon and Washington. This is not an arid region. In fact the annual precipitation ranges from 30 to 70 inches. Little attention is paid to irrigation except in parts of California and in the southwestern corner of Oregon. The region is devoted to diversified agriculture, horticulture, dairying, and grazing. It is quite heavily timbered and the public lands have been largely disposed of.

The future improvement and utilization of the vacant public

lands is an economic problem of national importance. The first question which arises in the minds of most persons in discussing this problem relates to the purpose and extent to which the present public lands can be utilized. It is generally admitted that they constitute a national resources of great value. The flagrant abuses of the federal land laws have called attention to the necessity of changes in the laws regulating the disposition of the public domain. A quite unusual interest in the vacant lands of the arid States has thus been awakened throughout the United States.

This interest manifests itself in the opposed positions assumed by writers on the subject. On the one hand it is argued that no changes should be made in the land laws, that the Government should not take active part in the development of the West but that these problems should be left for private enterprise. On the other hand, we have the advocates of changes in the land laws, and federal aid in the agricultural development of the West. The latter view took definite shape in the passage of the reclamation act.

The future development of the Western country will evidently depend greatly upon the better utilization of the public lands. This work should not be undertaken, however, without a thorough understanding of its natural limitations. The rainfall of the arid region is inadequate for farming purposes except on limited areas favorably located. The greater part of such land is already occupied for dry farming. While the annual precipitation varies in periodic cycles of 10 or 15 years, there is no evidence that it will ever become permanently greater. Agriculture, therefore, depends upon irrigation. The supply of water available for irrigation naturally varies with the flow of the streams, but it is everywhere limited. In many localities the present supply is fully utilized and any further increase must depend upon the construction of reservoirs. Finally, it should be remembered that only a small percentage of the public lands can ever be reclaimed for agricultural purposes. There are some areas of almost absolute desert with no available water. The main mountain ranges are covered with forests or are mere masses of rock interrupted with mountain meadows. The latter

are as a rule so high that monthly frosts occur and agriculture is impossible. Aside from the large areas which can not be utilized for any agricultural purposes whatever, there is only a small proportion of the remainder which is available for any purpose except grazing. When we read that there are 60,000,-000 acres of vacant public land in Nevada it does not mean that this area could be divided into 600,000 farms of 100 acres each. On the contrary, probably not more than 2 per cent can be reclaimed for farming. At present, less than 1 per cent of the total area of Nevada is improved land. The amount of improved land in New Mexico is .42 per cent, in Wyoming, 1.3 in Idaho 2.6 per cent, and in Colorado, 3.4 per cent of the total area.

These well known facts are mentioned not for the purpose of discouraging the settlement and development of the West but in order to place the problem upon a firm foundation and to counteract exaggerated statements which have been made regarding the possibilities of agricultural development in the arid region. As irrigation communities increase in size and compactness, land values will rise. More elaborate irrigation enterprises will then be demanded and will be justified from a conservative financial standpoint. The development of these and all the related industries of the West, however, will take place more rapidly and will be of a more permanent nature when all the natural limitations are clearly recognized. With these ideas in mind we have in the following chapter attempted to discuss the possibilities of grazing in the public land States.

### **GRAZING LAND AND GRAZING.**

*Area and description.* Of the various classes of public lands the grazing lands are by far the most extensive. There are about 400,000,000 acres of the public domain of which almost the only possible economic use is for grazing purposes. These lands extend westward from the one-hundredth meridian to the Pacific on the southwest, while in the northwest they are interrupted by large areas with a considerable annual rainfall. The boundaries of the grazing lands are difficult to define, partly on account of the variation in rainfall from year to year and partly

on account of the possibilities of more extensive development in irrigation enterprises.

Even from the most optimistic viewpoint it is impossible to believe that any considerable proportion of the grazing lands can be irrigated with the present water supply and under the present climatic conditions. Grazing must therefore remain the chief agricultural industry of the arid west. The economic importance of the grazing lands is sufficiently apparent from the following statistics taken from the census of 1900 concerning the numbers of live stock which subsist in the arid and semiarid States, viz.: 10,000,000 beef cattle, 7,900,000 dairy cows, 3,542,000 horses, 629,000 mules and 33,389,000 sheep.

One important characteristic of the western ranges is that they furnish forage throughout the year. The grass, unlike that of pastures in humid climates, does not lose its nutritive properties when it dries up in the fall. On the contrary, it then forms naturally cured hay of great value. This fact is so conspicuous that it was especially noted by nearly all the western explorers. Thus many of these explorers expressed surprise at the observed fact that exhausted horses turned loose to shift for themselves during winter were found in the spring in a fat condition. The highly nutritious character of range grasses has been so well understood by western cattlemen and sheepmen that until recently no attempt was made to provide any forage other than that which naturally grows on the range.

The grazing lands in various parts of the western States differ greatly in altitude, rainfall, soil, vegetation, etc. The most striking differences are observed in quantity and quality of vegetation. The term Prairie, Plains, and Desert were applied by the early explorers and settlers to three distinct classes of grazing lands and these terms have persisted in use with essentially their original meaning until the present time. The Prairies extended from the Mississippi westward for a distance of about two hundred miles; they were for the most part covered with tall, rank grasses. The Plains extended from the western borders of the Prairies to the foothills of the Rocky Mountains. They were and still are characterized by a covering of short, fine grass. The term Desert was applied to certain especially

dry and barren areas in Arizona, Nevada, Wyoming, and elsewhere. Strictly speaking, however, we have only about 70,000,000 acres of desert areas in the United States. Even in the most barren localities some grass and other plants are produced in the spring but quickly shrivel with the advent of the dry season. If this sparse vegetation is then destroyed by grazing, the soil may be left quite bare for the remainder of the season.

In general the grasses on the public range are shorter east of the Rockies than they are west of these mountains. This condition was observed by early travelers and is still substantially true, but the statement is subject to numerous exceptions. For example, in the eastern part of Montana there are extensive level plains on which the native grasses reach a height of 8 to 15 inches and form a fairly close sod. A few words with regard to the general conditions of the grazing lands may not be out of place here. They may occur in immense areas of comparatively level country, as for example the Great Plains. In the mountainous regions grazing is found on the rolling foothills, in large mountain basins, on high plateaus, and in the natural parks which are abundantly scattered throughout the forest lands. The size of the continuous areas of grazing lands thus varies from thousands of square miles to a few acres. The altitude of lands actually grazed at present varies from a few hundred feet to ten thousand feet or more. Grazing lands can not be considered as arable, for several reasons. That portion of them which is located at great altitudes in the mountains is subject to frosts during the whole summer season and can not therefore be used for the production of cultivated crops. Another portion in the mountains and foothills is of so rough and broken character that it is inaccessible to vehicles and machinery which might be used for harvesting crops. The extensive grazing lands of the Great Plains, Great Basin, and other large areas between mountain ranges west of the Continental Divide receive so little rainfall during average years that the raising of cultivated crops is a dangerous venture from a financial standpoint and results in failure except during occasional years of unusual rainfall. To be sure dry farming forms an industry of considerable im-

portance in certain arid regions, but the lands which are susceptible of treatment in this manner are usually located at the foot of mountain slopes in situations where it is impossible to get irrigation water but where considerable quantities of water are received by the soil through a process of seepage.

The water supply of the grazing lands varies greatly in different parts of the arid country. In some regions, as for instance Montana and the northwestern part of Wyoming, the distance between accessible streams may not be more than a few miles on any part of the range. In other localities no running water is to be found during the driest season, and stock have to depend on water in stagnant pools. There are areas of valuable grazing ground so poorly provided with water that grazing is possibly only in the winter season, when the stock are able to eat snow. Some of these tracts exhibit small streams in early spring after the melting of the snow, but as soon as this supply of water is exhausted the range must be abandoned. The distance to which stock can safety wander away from water during the grazing hours varies according to the kind of animal and the nature of the vegetation. Horses and cattle learn the location of the water supply on the range and travel long distances from this water in search of grazing. They can then travel back to the water once a day or every other day as necessity requires. With sheep, however, the case is somewhat different. These animals can not travel more than a few miles each day and on range which does not furnish succulent forage it is dangerous to drive them too far from a water supply. In certain parts of the southwest where exceedingly succulent forage plants are found on the range quite remarkable possibilities have been discovered in this regard. Sheep may be maintained on such ranges for periods of fifty to sixty days without water.

It thus appears that nearly all of the grazing country can be utilized by one or more species of domesticated animals at some season of the year. The great variation in the amount and character of the forage on different parts of the range has brought about the well established custom among stock raisers of dividing the range according to the conditions of the season and utilizing part in winter and another part in summer. Nat-

urally the winter range is located at lower altitudes than that which is utilized in summer. In winter the exceedingly dry and relatively barren tracts which are also as a rule comparatively free from snow may be successfully used for the maintenance of cattle, sheep, and horses in good condition throughout the cold season. In summer the higher tracts of grazing land are more abundantly supplied with water and furnish large quantities of comparatively green and succulent forage and, on account of the deep snows which occasionally prevail on such tracts in winter, it is impossible to use these grazing grounds at any other season than summer or early fall. This alternation forced upon stockmen by the exigencies of climate and natural conditions is a very fortunate circumstance, in so far as it prevents the continual use of any one tract of the range and thus allows a sufficient period each year for vegetation to recover from the effects of grazing during the remainder of the year.

*Range forage.* The forage plants which serve for the maintenance of domesticated animals on western ranges are of great variety. The grasses are naturally first in importance, but in addition to the grasses a great number of herbaceous plants, commonly called weeds by sheepmen and cattlemen, and shrubby plants, called "browse" furnish important forage material. The grasses which grow on the western plains include a large number of species and no attempt to enumerate them can be made in this connection. The names which are most frequently used by stock raisers are bunch grass, buffalo grass, grama grass, etc. Buffalo grass, however, is used by different stockmen to refer to different species of grass and a number of varieties of grama grass are known. Both of these grasses are short and of a fine texture as compared with the ordinary bunch grass. The term bunch grass has been applied to a great variety of grasses belonging to different genera and species. Their chief characteristic, as the name implies, is the habit of growing in tufts or bunches. No continuous sod is therefore formed and the ground is never completely covered. The forage value of these grasses depends somewhat upon the soil and amount of moisture where they grow. They are of great value for winter ranges on account of the fact that the bunches are usually of sufficient height and

rigidity to stand above the snow where they are readily accessible to domesticated animals. In the southwest, for example, in Arizona, the chief range grasses are black and blue grama, sacaton, and bunch grasses. In Montana, which is noted for the variety and abundance of its range grasses, the species of greatest economic importance are grama grass, bunch grasses belonging to *Poa* and other genera (there being ten or more important species of *Poa* in the State), June grass, bluejoint, fescue, *Danthonia*, wild rye grass, etc. Among forage other than grasses mention should be made of the following in Arizona: Plantain, creosote bush, saltbushes of the genus *Atriplex*, greasewood, cacti, and various legumes including mesquite, screw bean, lupines, species of *Astragalus*, etc. In the Great Basin the following plants are important for grazing: Several species of sagebrush, saltbushes, scrub oak, native species of clover, sedges, rushes, lupines, and other native species of legumes. These few notes may serve to give an idea of the great variety of plants which serve as forage for animals upon the open range.

*Deterioration.* At the present time the condition of the range is deteriorating in many localities. More and more complaints are heard each year of the destruction of grasses and the barrenness of the range. In many localities this has become so serious that doubts have been entertained as to the possibility of ever restoring the range to anything like its original productive capacity. In order to understand better what apprehensions may be felt in this direction and also what can be done to improve the range it seems desirable to examine the accounts of early explorers and settlers as to the conditions which they observed on the range and also as to the causes of deterioration or improvement which they observed. In examining these early records it should be remembered that the productiveness of the arid range country and the possibilities of animal industry under those conditions are usually but little appreciated by the average traveler or explorer. The general opinion as to the economic value of this country as expressed by various writers is often, therefore, quite incompatible with the observations incidentally made as to the conditions of the country along the route. The value of evidence obtained from early accounts with

regard to the productiveness of the range and the conditions of the grasses can scarcely be overestimated, since these accounts were largely in the nature of diaries and the notes were written down each day as the various observations were made. As a rule the context of these accounts also indicates conclusively that the remarks concerning the range were quite incidental and represent a perfectly true picture of the country as seen by the different observers. The general opinions expressed regarding the western country as a whole may often have been and probably were in many instances influenced to a considerable extent by preconceived opinions of the explorers or by comparison with other literature sometime after the completion of the journey. All short notes by the way, however, made on the day of the various observations must be considered as true accounts. Moreover, with regard to the value of the testimony as to the early condition of the western range country, these written accounts are usually more reliable than statements made from memory twenty-five or thirty years after the occurrence of the events which are chronicled. It thus happens that statements made at the present time by old settlers concerning the condition of the country in the 60's and 70's may be much exaggerated or unduly influenced by the changed conditions of the range.

*Early opinions.* As a rule the opinions of statesmen and their interest in one way and another in the western country were adverse to that region and these statements repeatedly made in congressional speeches and in newspaper articles and tracts prejudiced many explorers and settlers who subsequently went west to investigation the actual conditions for themselves. A few illustrative statements from the thousands which could be quoted are here reproduced. In a letter of instruction to Galatin and Rush, American representatives on the Oregon Boundary Commission, J. Q. Adams declared that in that region "there is no object to any party worth contending for." In 1824 Senator Dickerson in a speech stated, "As to the Oregon Territory, it can never be of any pecuniary advantage to the United States." In 1804 the Federal Government first undertook in a serious way the exploration of the country west of

the Mississippi, and from this first famous expedition of Lewis and Clark until the 60's and 70's a large number of expeditions, chiefly under the direction of the War Department, were made into that country for the purpose of learning more definitely its natural conditions and the possibilities of its development. In 1819 and 1820 an extensive expedition was carried out under the command of S. H. Long, and as a result of his explorations general recommendations were made regarding the nature of the country and its economic importance. Long is perhaps chiefly responsible for disseminating the belief in the uselessness of the western country. The idea of the "Great American Desert" was first definitely formulated by him and the territory covered by it was made to include practically the whole United States west of the western boundary of Iowa. Two paragraphs from his report are sufficiently interesting to quote in this connection:\*

"In regard to this extensive section of country, we do not hesitate in giving the opinion that it is almost wholly unfit for cultivation, and of course uninhabitable by a people depending upon agriculture for their subsistence. Although tracts of fertile land, considerably extensive, are occasionally to be met with, yet the scarcity of wood and water, almost uniformly prevalent, will prove an unsurmountable obstacle in the way of settling the country. This objection rests not only against the immediate section under consideration, but applies with equal propriety to a much larger portion of the country. Agreeably to the best intelligence that can be had concerning the country both northward and southward of the section, and especially to the inferences deducible from the account given by Lewis and Clark, of the country situated between the Missouri and the Rocky Mountains, above the river Platte, the vast region commencing near the sources of the Sabine, Trinity, Brazos, and Colorado, and extending northwardly to the forty-ninth degree of north latitude, by which the United States territory is limited in that direction, is throughout of a similar character. The whole of this region seems peculiarly adapted as a range for buffaloes,

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\* Pittsburgh to the Rocky Mountains, 1819, 1820, compiled by E. James, Vol. II., p. 361.

wild goats, and other wild game, incalculable multitudes of which find ample pasturage and subsistence upon it.

"This region, however, viewed as a frontier, may prove of infinite importance to the United States, inasmuch as it is calculated to serve as a barrier to prevent too great an extension of our population westward, and secure us against the machinations or incursions of an enemy, that might otherwise be disposed to annoy us in that quarter."

This idea of the Great American Desert immediately found numbers of adherents and was reechoed in the literature relating to the western country for years after the publication of Long's report. The boundaries of the supposed desert were gradually restricted as more detailed explorations of various parts of the country were made until they became confined to the Great Gasin. Later, even this region ceased to be called a desert and the term was then used largely as descriptive of certain especially barren areas in Arizona, Wyoming, Nevada, and other regions. Not all the explorers, however, were unfavorably impressed with the conditions prevailing on the range, even at the beginning of the nineteenth century. Thus, Fremont<sup>1</sup> frequently speaks of the immense value of the Western regions, especially for grazing purposes. Brackenridge<sup>2</sup> considered the first 200 miles westward from the Mississippi good for settlement, while in his opinion the next 300 miles "can scarcely be said to admit of settlement." A large proportion of the rest of the country east of the Rockies appeared to him to be fertile agricultural soil. "In these vast plains throughout which are scattered so many lovely spots capable of supporting thousand of such nations as the Arikaras or the wandering Sioux a few wretches are constantly roaming about seeking to destroy each other;" and on p. 235 Brackenridge says "The natives will probably remain in quiet and undisturbed possession for at least a century, for until our country becomes in some degree surcharged with population there is scarcely any probability of settlers venturing into those regions." On p. 236 of Bracken-

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<sup>1</sup> The Exploring Expedition to the Rocky Mountains, Oregon, and California, 1842-1844.

<sup>2</sup> Voyage up the Missouri in 1811, p. 227.

ridge's account we find the following statement, "This country can never become agricultural, but it is in many respects highly favorable to the multiplication of flocks and herds." As a whole, however, the Louisiana Purchase was considered of great importance and "the intrinsic value of Louisiana, notwithstanding the vast extent which may be considered almost barren, is beyond calculation."<sup>1</sup>

John Bradbury, who explored the Missouri at the same time, was even more favorably impressed with the advantages of that country.<sup>2</sup> Speaking of the vast prairies, Bradbury says "It will be one of the most beautiful countries in the world . . . . In almost every part where I saw it in a state of nature it was covered with the finest verdure imaginable."

Again in the same report<sup>3</sup> he says "The political and commercial advantages that will arise to the United States from the acquisition of Louisiana are incalculable, besides the vast revenue that will arise from the sale of lands." In speaking of the Upper Missouri Bradbury says "When the great extent of this plain and its fertility in grazing are considered we cannot but admit that the number of animals it is capable of containing must be immense."

Marcy<sup>4</sup> states that "Grass everywhere on Red River and its tributaries is of a very superior quality, consisting of several varieties of grama and mezquite." Again he says<sup>5</sup> "The whole surface of the country from Red River to Rio Grande is covered with a dense coating of the most nutritious grass which remains green for nine months of the year, and enables cattle to subsist the entire winter without any other forage."

Thomas Nuttall<sup>6</sup> states that in his opinion "Ages must elapse before this kind of land will be worth purchasing at any price."

Parker<sup>7</sup> expresses a very favorable opinion of the country along the Platte River "For about twenty five miles since we

<sup>1</sup> Loc. cit., p. 239.

<sup>2</sup> Travels in the Interior of America, 1809-1811, p. 272.

<sup>3</sup> Travels in the Interior of America, 1809-1811, p. 227.

<sup>4</sup> The Exploration of the Red River of Louisiana, 1852, p. 30.

<sup>5</sup> The Exploration of the Red River of Louisiana, 1852, p. 123.

<sup>6</sup> A Journal of Travels into the Arkansas Territory in 1819, p. 113.

<sup>7</sup> Journal of an Exploring Tour Beyond the Rocky Mountains, 1835, p. 50.

crossed the Elkhorn and between this river and the Platte, which are about ten miles apart, there is not a single hill. It is a rich bottom land covered with a luxuriant coat of grass. No country could be more inviting to the farmer. . . . . The time will come and probably is not far distant when this country will be covered with a dense population. . . . . Then this amazing extent of most fertile land will not continue to be the wandering ground of a few thousand Indians with only a few acres under cultivation, nor will millions of tons of grass grow up to rot upon the ground or be burned up with the fire kindled to sweep over the prairie and disencumber it of its spontaneous burden."

Brockett<sup>1</sup> in speaking of the so-called Great American Desert, says "There are many millions of acres of grazing lands where all the flocks and herds of the continent could find good pasture."

Hazen<sup>2</sup> states his belief that "From the one-hundredth meridian to the Sierra Nevada Mountains, a distance of twelve hundred miles, there is not more than one acre to the hundred that has any value for agricultural purposes or that will sell for the next hundred years."

These opinions, which could be multiplied almost indefinitely, are those of travelers and explorers who actually saw more or less of the country of which they were speaking. The opinions of members of congress and newspaper writers expressed during the period in which an accurate knowledge of the western country was being most eagerly sought are still more at variance, more exaggerated in one direction or the other, and while interesting from a historical standpoint, are of little value in gaining a knowledge of the actual conditions which prevailed in the western country. As previously stated, it is considered of much importance to secure definite ideas concerning the grazing possibilities and the condition of the grass upon the range in the early days of western settlement, and particularly to obtain evidence relating to the influence of various agencies in modifying range conditions. It is believed that a study of these

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<sup>1</sup> Our Western Empire, 1882, p. 27.

<sup>2</sup> North American Review, 1878.

conditions, so far as they can be obtained from an examination of early writings, will serve as a firm basis for generalizations as to the possibilities in the present and future utilization and improvement of the range and grazing industries.

Immediately following upon the expedition of Lewis and Clark a suddenly increasing number of persons was attracted into the far western country. The objects of the expeditions thus planned and executed were manifold. Some were seeking homes others precious metals, while a large number were engaged in hunting, trapping, or more adventure. The numerous books, government reports, and articles in periodical literature written for the purpose of describing the western country and its possibilities naturally contain statements regarding the conditions of the grass in all parts of the western country. The necessity of obtaining forage for horses, mules, and oxen which were used on these expeditions compelled accurate observations with regard to the height, quality, and abundance of various grasses in different parts of the region covered by each exploration. It thereby becomes possible to obtain a fairly complete series of statements regarding the quantity and quality of grass in any particular locality, extending back over a period of from forty to one hundred years or more. For present purposes, however, only a comparatively small proportion of these statements can be advantageously utilized. Special attention has been given, in looking over these various accounts, to statements regarding the effect of grazing upon the range in early days, and also the effect of fires, drought, etc.

*Buffaloes.* At the present time the most important cause of deterioration in the range is overgrazing, and doubts have been expressed by many agricultural writers and stockmen as to the possibility of the range recovering from effects of overgrazing. It is interesting in this connection to examine briefly the effects of the grazing of the innumerable herds of buffalo, which predominated over all other animals upon the range at the time of the earliest settlement of the western country. That these animals must have been an important factor in this problem is apparent from a mere consideration of their immense num-

bers. C. J. Jones<sup>1</sup> gives the following statistics, on the basis of his estimates, of the number of buffalo on the range, in 1865, 15,000,000; in 1871, 12,400,000; and in 1875, 1,000,000. The number of these animals in the days of their greatest abundance was therefore considerably in excess of the present number of cattle which occupy the same range. Since it may be assumed that the buffalo require as much for sustenance as domesticated cattle, it is but natural to suppose that large quantities of grass would be eaten by them. While the buffalo ate nearly all kinds of grass and some shrubbery, it seemed to prefer the buffalo grass over the greater part of its natural range. In speaking of this grass, Bell<sup>2</sup> states that "Its close, thickly matted fibers keep the ground very dry by preventing the rain from penetrating into it. I have noticed times and again after a sudden thunder shower how rapidly the rain flowed off into the gullies, filling up the streams and helping to cause those sudden floods which so often harassed us on our march. Doubtless no grass could bear so well the heavy tramp of thousands of buffalo . . . . but . . . . as settlers advance deeper rooted grasses take its place . . . . opening up the soil and retaining the moisture in the ground."

Gilpin<sup>3</sup> estimates that the number of buffalo, wild horses, and elk together amounted to not less than 100,000,000 in the year 1873. With regard to the number of buffalo which actually traveled in one continuous herd there are hundreds of statements in the reports of travels, and these statements naturally vary according to the time of year and the tract of country covered by the traveler. The number of buffalo in moderately large herds is usually estimated at from 10,000 to 100,000. Greely, however,<sup>4</sup> gives the following account of an immense herd which he observed. "I know a million is a great number, but I am confident that we saw that number yesterday. Certainly all we saw could not have stood on ten square miles of ground. . . . The soil is rich and well matted with their favorite grass, yet it

<sup>1</sup> H. Inman, Buffalo Jones' Forty Years of Adventure, p. 255.

<sup>2</sup> New Tracks in America, 1869, Vol. I., p. 42.

<sup>3</sup> Mission of the North American People, 1873, p. 72.

<sup>4</sup> An Overland Journey from New York to San Francisco, 1859, p. 87.

is all (except a very little on the creek bottoms near to timber) eaten down like an overtaxed sheep pasture in a dry August."

Perhaps the largest estimate which has ever been made of a single continuous herd of buffalo related to a herd seen by R. I. Dodge in 1871. The data and figures given by Dodge were examined by Hornaday.<sup>1</sup> After making allowance for all factors which could be concerned in the case, Hornaday makes large reductions from the possible figures "which would leave 4,000,000 as our estimate of the actual number of buffaloes in this great herd, which I believe is more likely to be below the truth than above it."

When Lewis and Clark reached the Great Falls of the Mis-souri, in 1805 they found<sup>2</sup> that the soil was very much cut up by buffaloes. "The grass, which is naturally short at this time, is still more so from the recent passage of the buffalo." Long,<sup>3</sup> when speaking of the country at the forks of the Platte, says that there was a "verdant plain" upon which thousands of buffalo were grazing. On the south side of the South Platte "The Plains are more closely depastured, the grass is fine and short." J. A. Allen,<sup>4</sup> referring to the annual northern and southern movements of these animals, says, "The route which these animals follow in their migrations occupies a width of several miles and becomes so marked that, besides the verdure destroyed, one would believe that the fields had been coverd with manure." Parker<sup>5</sup> says that where buffaloes had recently grazed it was exceedingly difficult to find enough grass for the horses. Raynolds<sup>6</sup> speaks of the destruction of grass by buffaloes on Powder River. "At a few low points we found a coarse grass that the buffaloes had rejected. but our mules ate it with avidity." At another point "The grass on the river surpassed our expectations in quality, thus in-

<sup>1</sup> The Extermination of the American Bisons, Smithsonian Rpt. 1887, Part 2, p. 391.

<sup>2</sup> Lewis and Clark's Journal, Reprint of 1814 Edition, 1902, Vol. I., p. 362.

<sup>3</sup> Loc. cit., Vol. I, pp. 469, 470.

<sup>4</sup> The American Bisons, pp. 129, 130.

<sup>5</sup> Loc. cit., p. 61.

<sup>6</sup> Yellowstone River Explorations, 1859, 1860: Fortieth Congress, First Session, Sen. Doc. 77, p. 36.

dicating that the buffalo had been in the valley but a short time."<sup>1</sup>

The accounts indicate what would naturally be expected, viz., that where buffaloes congregated in immense herds the grass was totally destroyed for the time and the ground was much cut up or packed down, according as dry or wet weather prevailed. The result of such accumulations of large herds, however, was the apparent total destruction of the grass. Even in the days of the great cattle kings of the west the herds of cattle were comparatively small, numbering only a few thousands. It is therefore apparent that injury to the range on account of overcrowding and overgrazing from cattle was then and is now a quite unimportant factor in the destruction of the range as compared with the enormous herds of buffalo. It should be remembered, however, that despite the fact of apparent total destruction wrought by the buffalo along the line of their migrations and during their close association at breeding seasons, the range recovered so that the evidence of their destructive grazing was entirely lost within a few years. This fact indicates also the possibility of range improvement at present. The buffaloes, after passing through a range and destroying the grass, did not return by that route or visit the range again until the grass had recovered from the effects of overgrazing, and since climatic and soil conditions on western ranges have not changed to an appreciable degree since the earliest historical times, it may be reasonably assumed that even ranges which have been most abused by overgrazing have excellent prospects of recovering their former productiveness if allowed a seasonable resting period.

*Wild horses.* The early western travelers speak of large herds of wild horses which roamed about on the plains, especially in the Southwest and along the Arkansas. Gregg,<sup>2</sup> in writing of the mustang, says "he is familiarly known by common report all over the great prairies." Jones<sup>3</sup> in 1875 estimated the number of wild horses in Texas, Colorado, Kansas, and Nebras-

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<sup>1</sup> Yellowstone River Explorations, 1859, 1860: Fortieth Congress, First Session, Sen. Doc. 77, p. 37.

<sup>2</sup> Commerce of the Prairies, 1844, Vol. II., p. 207.

<sup>3</sup> H. Inman, Buffalo Jones' Forty Years of Adventure, p. 169.

ka at 50,000. They were at that time considered as practically exterminated except in the Southwest. Kern<sup>1</sup> in 1845 had occasion to observe the effect of grazing of wild horses at Lake Fork on Humboldt River. He had great difficulty in securing forage for his animals, "the grass and shrubbery having been destroyed by the wild horses." The mustangs have always caused great destruction to the range and are still a source of annoyance to stock raisers of the West and Southwest. In fact the wild horse nuisance is a very important factor in the range problem<sup>5</sup>.

*Prairie dogs.* These animals are generally distributed throughout the Great Plains and occur in colonies (dog towns) of varying size. The largest colony is in Texas and covers an area of 100 by 250 miles, or 25,000 square miles. The average number of prairie dogs per acre is about 25, and it has been estimated that 32 prairie dogs will eat as much as 1 sheep and 256 as much as 1 cow. In the region of the dog towns the destruction of grass is estimated at 50 to 75 per cent of the range capacity.<sup>2</sup> J. R. Bartlett<sup>3</sup> found the grass very short and poor in prairie dog towns in Texas (1850). J. G. Smith<sup>4</sup> states that in Texas the destruction of grass by prairie dogs and jack rabbits is of great extent and importance. Unusual efforts are being put forth to destroy these animals especially in Kansas and Nebraska and their numbers are being somewhat reduced. Their effect upon the range grasses, however, is still apparent even to a casual observer.

*Locusts.* In the time of Spanish settlement and in the early days of American agricultural settlement west of the Mississippi, the range grasses and other vegetation were destroyed in greater or less areas during the prevalence of locust plagues. Riley<sup>6</sup> states that "wild prairie grass is relished when young and tender, but usually little injured when mature." Yet cases are on record by travelers in the Northwest even during the last century, of the wild grass being so effectually mowed down by these lo-

<sup>1</sup> J. H. Simpson, Explorations Across the Great Basin of Utah, p. 485.

<sup>2</sup> C. H. Merriam, Yearbook U. S. D. A., 1901, p.

<sup>3</sup> Personal Narrative, etc., Vol. I., p. 69.

<sup>4</sup> Division of Agrostology Bul. 16, p. 14.

<sup>5</sup> Bureau of Plant Industry Bul. 38, p. 44.

<sup>6</sup> U. S. Entomological Comm., 1878, p. 252.

custs as to render it difficult to find feed for horses." Venegas<sup>1</sup> refers to a locust plague during the years 1722 and 1723 on the Colorado River. All grass and herbage was destroyed and many domestic animals and Indians starved to death as a result. Lewis and Clark<sup>2</sup> in 1805 found the grass about 3 inches high near the Great Falls of the Missouri and badly eaten by locusts. Long<sup>3</sup> observed a migratory swarm of locusts on the summit of Pike's Peak, the air being literally filled with them. Fremont<sup>4</sup> found that the grasshoppers had destroyed all the grass on the Laramie Plains in 1842. The occurrence of locust plagues was irregular but quite frequent in the days of the western pioneers, and their injury to grass on the plains and even in the mountain meadows was of great importance. Fortunately, locusts have become greatly reduced in numbers during recent years, and their effect upon range conditions correspondingly diminished.

*Fires.* Before the western country became settled by white people, the prairies and great plains were subject to annual fires of great extent and violence. These fires were set by Indians, and later by hunters and trappers, for the purpose of driving game to certain restricted localities where they might be more easily surrounded. Still later the idea prevailed that the forage was improved for the coming year by burning the dead grass in the fall.

Cabeza de Vaca,<sup>5</sup> in 1535, remarks concerning the Arkansas country that "they (Indians) take the pasturage from cattle (buffaloes) by burning, that necessity may drive them to seek it in such places as it is wished they should go." Bartlett<sup>6</sup> states that in Taxes the grass was burned off in October. E. F. Beale<sup>7</sup> observed that emigrants frequently set fire to the prairies through carelessness. Bell<sup>8</sup> speaks of annual autumn prairie fires which also killed shrubs and trees. The treelessness of the

<sup>1</sup> History of California, 1758, Vol. II., p. 37.

<sup>2</sup> Loc. cit., Vol. I., p. 353.

<sup>3</sup> Loc. cit., Vol. II., p. 31.

<sup>4</sup> Loc. cit., p. 72.

<sup>5</sup> Narrative of Alvar Nunez Cabeza de Vaca, translated by B. Smith, p. 64.

<sup>6</sup> Loc. cit., Vol. I., p. 83.

<sup>7</sup> Central Route to the Pacific, etc., 1853, p. 23.

<sup>8</sup> Loc. cit., Vol. I., p. 41.

plains is ascribed by Bell and other authors to these fires. Bonneville<sup>1</sup> states that along the Platte River the grass was so short that the hunters could not set fire to it. A similar statement is made by William Gilpin.<sup>2</sup> No annual fires ever sweep over the Great Plains; these are confined to the prairie region." R. I. Dodge<sup>3</sup> calls attention to the fact that "the Indians burn portions of the prairie every fall."

It may therefore be safely asserted that the grass was burned annually, or nearly so, wherever it was tall enough to carry a fire rapidly. These fires in the days of early western settlement extended over immense areas and developed an intensity of heat which varied according to the height and abundance of the grass, winds, etc. The appearance and condition of the ranges were thereby greatly modified but there is not a complete agreement among the authorities as to the effect of the fires upon the productivity of the ranges. Maximilian zu Wied<sup>4</sup> passed by the mouth of Little Sioux River on May 6, 1832, and observed that "überall fand sich ein frischer Graswuchs allein auch nicht eine einzige Bluthe, welche durch das Anzünden der Prairie verursacht wird." The tolerance of fire by grasses and the simultaneous destruction of other plants have been noted by other observers. While traveling from St. Louis to Council Bluffs in 1820 Long<sup>5</sup> observed that "the plains had been perfectly denuded by the burning of the last season and the annual growth of grass and weeds had as yet risen but about a foot from the ground." This was during the first part of June, however, and was a good height for the grass. Cyrus Thomas<sup>6</sup> considered that fires had at least one beneficial effect, "Wherever a fire has swept up the mountain side destroying the pine tree . . . there springs up in a marvelously short space of time a tall green grass." Griffiths,<sup>7</sup> however, while studying the grazing conditions in the Great Basin came to the conclusion that "burning is as destruc-

<sup>1</sup> Irving's Adventures of Capt. Bonneville, Pawnee Edition, Vol. I., p. 45.

<sup>2</sup> Mission of the North American People, 1873, p. 72.

<sup>3</sup> The Plains of the Great West, 1877, p. 29.

<sup>4</sup> Reise in das innere Nord-Amerika, 1832-1834, Vol. I., p. 303.

<sup>5</sup> Loc. cit., Vol. I., p. 416.

<sup>6</sup> Agricultural Resources of the Territories, 1871, p. 269.

<sup>7</sup> Bureau Plant Industry Bul. 15, p. 31.

tive to the grass of the ranges as to the trees of the forest." Different grasses were differently affected. The fescues were all killed while the Nevada blue grass recovered nicely. On the Dakota prairies fires seemed to have a worse effect than overgrazing. L. H. Pammel\* is still more emphatic on the bad effects of fire. "A forest burnt over is absolutely sterile for a term of years as far as forage plants are concerned. The fire not only destroys whatever turf there is but it prevents reseeding."

The extent and frequency of range fires have gradually decreased as the country has become more thickly settled, but these fires are still an important factor in the range problem. Some are of accidental origin-sparks from trains, neglected camp fires, lightning etc. Some are purposely set with the belief that the range will be thereby improved, or in order to destroy brush and timber and thus extend the area of grass. In other localities fires are maliciously set in the perpetuation of some feud or controversy concerning the range.

In our opinion no good arguments have been advanced in favor of burning the range. In some localities it requires from 3 to 5 years for the range to recover from the effects of a single fire. In other places we have observed a good growth of grass during the season following a burn. The grass is always injured to some extent, however, and no benefits can be claimed from burning. The amount of damage naturally varies according to the intensity of heat developed by the flames, the time of year, kind of grass, character of the turf and dryness of the season. In the range country all dead grass is highly nutritious and valuable for winter grazing. All grass fires, therefore, cause a direct loss to the grazing industry. Moreover, cattle and horses sometimes "drift" upon extensive burned areas in winter storms and die of starvation, and sheep are occasionally burned to death by being caught in range fires.

*Opinions on range forage.* Thus far we have discussed several agencies which have affected the production of the range grasses in the past, viz:—Buffaloes, wild horses, prairie dogs, locusts, and fires. The buffalo has been eliminated as a factor in the range problem. The other agencies, however, are still

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\* Division of Agrostology, U. S. D. A., Bul. 9, p. 14.

operative, although greatly reduced in importance. We have now to consider the factor of grazing by sheep and cattle and to study the grazing industry in relation to the question of range preservation and improvement.

We shall first present data obtained from historical sources concerning the actual conditions of the range grasses in various parts of the country in former years. The changes which have taken place on the range may then be determined by comparison with present conditions, and the causes of improvement or deterioration may be conveniently studied.

With regard to general grazing conditions in the West the following data should be considered as additional to the statements of Long, Fremont, Parker, Bradbury, et al., quoted above. W. H. Emory<sup>1</sup> says "these plains west of the 100th meridian are wholly unsusceptible of sustaining an agricultural population, until you reach sufficiently far south to encounter the rains from the tropic;" and on page 49 of the same volume he speaks of grazing as one of the chief sources upon which the western population must depend. T. J. Farnham<sup>2</sup> considered the first 200 miles west of the Mississippi as agricultural, while the country for 200 miles east of the Rocky Mountains was called the Great American Desert. The belt between these two regions was denominated "Great Prairie Wilderness." Gregg,<sup>3</sup> as a result of his numerous trips across the plains between 1830 and 1843, came to the following conclusion: "The Neosho River seems to form the western boundary of the truly rich and beautiful country of the border . . . all the country that lies beyond is of a far more barren character." Long<sup>4</sup> states that between the Mississippi and Missouri the country was generally covered with a luxuriant growth of grass, while the region between the 96th meridian and the Rockies and between the Missouri and Red rivers exhibited no vegetation upon the uplands except withered grass 2 or 3 inches high. Along the Kansas River the high, coarse grasses greatly impeded the progress of the horses.

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<sup>1</sup> Report on the United States and Mexico Boundary Survey, 1857, Vol. I., p. 47.

<sup>2</sup> Travels in the Great Western Prairies, 1843, p. 22.

<sup>3</sup> Loc. cit., Vol. I., p. 58.

<sup>4</sup> Loc. cit., Vol. II., pp. 341 and 352.

*Arkansas country.* Cabeza de Vaca<sup>1</sup> says that the Indians guided him over 150 miles of desert country along the Arkansas, and states that the country had then (1535) suffered from a drought for 2 years. Long<sup>2</sup> speaks of "a broad expanse of waving prairie" along the Arkansas. Along the Canadian Fork "herds of bisons, wild horses, elk, and deer are seen grazing in these extensive and fertile pastures." Nuttall,<sup>3</sup> while on the Mississippi near the mouth of the Arkansas found that a scourin rush (*Equisetum hyemale*) was the most important winter fodder for cattle and horses in that country. Pasturage in the Arkansas Valley was abundant at all seasons of the year. On James Fork was a "prairie full of luxuriant grass about knee high."

Pike<sup>4</sup> found the grass along some parts of the Arkansas like that of salt meadows. Pasturage was poor. Grass was short on Smoky Hill Fork but tall on Republican River.

*Montana.* Among the references to the condition of the range grasses in Montana in former years we select a few which can be most easily compared with present conditions. F. W. Anderson<sup>5</sup> states that in southern and western Montana "the high plains or benches for the most part produce a very thin growth of grass," while in northern and eastern Montana "rolling plains thickly covered with grass" were observed. Hayden<sup>6</sup> found the vegetation around Fort Ellis very abundant. Peter Koch<sup>7</sup> speaks of the "desolate sagebrush covered plain" at the mouth of the Musselshell. The country was heavily grazed during this period, however, as shown by the following quotation: "In March, 1870, I traveled from Musselshell to Fort Browning on Milk River and for a distance of 40 miles I do not think we were ever out of easy rifle shot of buffalo." Mullan<sup>8</sup> found good grazing along Dearborn and Sun Rivers, "From the

<sup>1</sup> Loc. cit.

<sup>2</sup> Loc. cit., Vol. II., pp. 143 and 355.

<sup>3</sup> Loc. cit., pp. 58, 78, and 147.

<sup>4</sup> Expedition Through Louisiana Territory, 1806, 1807, Appendix to Part III., p. 31.

<sup>5</sup> Report Commissioner for Agriculture, 1888, pp. 313, 314.

<sup>6</sup> Survey of Montana, etc., 1871, p. 44.

<sup>7</sup> Contrib. Hist. Soc. Montana, Vol. II., pp. 293 and 302.

<sup>8</sup> Report on the Construction of a Military Road from Fort Walla-Wana to Fort Benton, 1858-1862, p. 43.

Columbia to the Missouri River finer grasses have never anywhere been seen. Wild hay can be and is cut from thousand of acres. The grass is mostly a wild bunch grass growing from 12 to 18 inches high and covering the entire country. Horses and horned stock by thousands and sheep by hundreds all bespeak the wealth that is locked up in the native grasses." John Mullins<sup>1</sup> speaks of excellent grass" at Fort Benton, in the Judith Basin and in the Musselshell Valley. Along the divide between the Yellowstone and Missouri "as we travelled eastward the soil became better and the grass was more plenty." F. L. Scribner,<sup>2</sup> speaking of Central Montana, says "*Poa tenuifolia* may well be considered *the* grass of the country. No species withstands the long summer drought so well and it constitutes the chief forage upon the dry bench lands . . . In the drier soils the culms are low, less than a foot" etc. At present this bunch grass is partly replaced by grama grass, throughout the region of which Scribner speaks. F. A. Spragg<sup>3</sup> remarks concerning this same area "the difference, then, between the overstocked range of today and the luxuriant growth of former times is to be found simply in the relative abundance of the blue grama." Stevens<sup>4</sup> states that between the Missouri and Mouse rivers the grass was scanty on the ridges but good for grazing, while in the bottoms the grass was rank but of inferior quality. The Missouri and Milk River valleys were "well grassed." Excellent grass was found far up Milk River and in the Teton Valley. On Milk River 50 miles above Bear Paw Mountains the range was rather barren. The grazing was "exceedingly good" on Sun River and the Flathead Indian Reservation was well grassed. Bitter Root Valley was "covered with an excellent growth of grass." Stevens states that between the Missouri and Milk rivers there was "an exceedingly fine grazing country." Around Highwood and Judith mountains there was "an extraordinarily fine grazing country." About the forks of the Missouri there were "rich' extensive and beautiful meadows and prairies." The "broad and

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<sup>1</sup> Fort Benton to Mouth of Yellowstone by Land, 1860, pp. 162-170.

<sup>2</sup> Agricultural Grasses of Montana, 1883, 66. 7, 8.

<sup>3</sup> Montana Sta. Bul. 26, p. 9.

<sup>4</sup> Explorations for Pacific R. R., St. Paul to Puget Sound, 1853-1855, pp. 69-110, and pp. 217-220.

fertile Deer Lodge Prairie" is also mentioned. In the Bitter Root Mountains there was "almost everywhere a fine growth of grass." On the eastern slopes of these mountains prairies were to be seen "covered with luxuriant grass." Fine pastures were found even on the highest parts of the range.

R. E. Strahorn<sup>1</sup> in discussing the range conditions says, "The height of bunch grass is usually 12 to 18 inches. I have seen miles and miles of bench lands along the mountain slopes which were one vast sea of bunch grass fully 30 inches high and thick enough to mow." On page 23 of the same volume R. N. Sutherlin reports excellent grazing conditions around Virginia City. In an edition of the Rocky Mountain Husbandman for May 7, 1903, Mr. Sutherlin sums up his observations on the range grasses of Montana for a period of thirty seven years. He emphatically denies that the range is being ruined by overgrazing. "Looking out over our State we can discern no material change in the conditions with reference to vegetation through all these years." Thomas<sup>2</sup> states that the Judith Basin was "covered with good grass," but that the regions bordering the Judith Valley were "barren and assumed the appearance of bad lands." "Montana is the best grazing section of the Rocky Mountain region. Not only are the open plains and prairies covered with rich and nutritious grasses, but also the smooth hills and naked mountain slopes, and the same rich carpet continues even beyond these far up into the timber."

*The Platte country.* The number of early references to the condition of the range along the Platte is almost beyond computation. The Overland Trail passed through this country and all of the emigrants to Sante Fe, Oregon, and California traveled through some of the Platte region. In fact the Great Plains of most tourists and travelers lay on the bench lands along the Platte. We select from this mass of literature a few statements illustrating the range conditions during the past century as noted at different times by different observers.

<sup>1</sup> The Resources of Montana Territory, etc., 1879, p. 23.

<sup>2</sup> Loc. cit., pp. 267-269.

D. Barnes<sup>1</sup> gained the impression that "a large portion of the prairies are good for nothing and never can be cultivated." "For 300 miles east of the Rocky Mountains no tree or shrub and but little grass appears." "Twenty five miles east of the North Platte commences the desert in earnest." Bonneville,<sup>2</sup> writing of the Platte River country says, "In these regions there is a fresh, sweet growth of grass in the spring, but it is scanty and short and parches up in the course of the summer." S. Bowles<sup>3</sup> says that from the North Platte to Green River the country is a desert with almost no vegetation. A. Delano<sup>4</sup> speaks of the "grass covered sand hills which bounded the valley of the Platte." H. Dodge<sup>5</sup> found the lower Platte Valley green and fertile. Near Grand Island the grass was thin and short. At the forks of the Platte he found the "grass short, thick, and dry, the grazing being good." Near the mouth of Cache de la Poudre "there is first a low flat, from half to a mile and a half wide where the grass is good . . . Above this is another bench of about the same width. The grass upon this, which is called buffalo grass, is short, thick, and dry. Above this is still another bench where the sand hills commence . . . The only vegetation upon them is a pieces of wild sage." Hayden<sup>6</sup> observed "scanty but very nutritious grasses" in the Nebraska sand hills. Throughout western Nebraska "thick, low, sweet, nutritious grasses cover the entire suface." Long<sup>7</sup> found the country barren between Loup Fork and the Platte. Beyond the bottom lands of the Platte as a whole "the surface is an undulating plain presenting the aspect of hopeless and irreclaimable sterility." McClure<sup>8</sup> gives the following description: "from Omaha to the North Platte the country is beautiful prairie . . . but . . . about Ft. Kearney and thence westward there is but one continued plain, parched . . . altogether inhospitable, bleak

<sup>1</sup> From the Atlantic to the Pacific, Overland, 1866, pp. 26, 27, and 49.

<sup>2</sup> Loc. cit., Vol. I., pp. 45, 46.

<sup>3</sup> Our New West, 1869, p. 38.

<sup>4</sup> Life on the Plains, 1854, p. 47.

<sup>5</sup> Journal of Expedition to Rocky Mountains in 1835, 24th Cong., 1st Session, House Doc. No. 181, pp. 7-20.

<sup>6</sup> Survey of the Territories, 1870, pp. 108-111.

<sup>7</sup> Loc. cit., Vol. I., 451, 459 and 469.

<sup>8</sup> Three Thousand Miles Through the Rocky Mountains, 1869, p. 53.

and desolate." Parkman<sup>1</sup> found that in the Platte country "the vast plains waved with tall, rank grass that swept our horses' bellies;" nevertheless he refers to the region as a "gloomy, barren prairie." Raynolds,<sup>2</sup> while camped on Deer Creek, a tributary of the Platte, found that "exhausted animals turned out to winter on the plains, came out in the spring in the best condition."

*Region of the Snake and Columbia River.* Bonneville<sup>3</sup> states that the valley of the Snake was usually well grassed. Franchere<sup>4</sup> reported good grazing along the Willamette River and the great part of the Columbia. Above the Dalles there was "nothing but bare hills" with little grass. Hayden<sup>5</sup> looked upon the country about Fort Hall as "a real oasis," while the region around Henry Lake was a beautiful grassy valley. McClure<sup>6</sup> refers to southern Idaho as a "dreary, sterile waste." Stephens found that between the Snake and Walla Walla Rivers the "grass was uniformly good" as also from the Walla Walla to the Palouse region.

*The Southwest.* There is perhaps no part of the United States concerning which so much has been written as the Southwest. The following statements extracted from this mass of literature may serve to convey an idea of the early grazing conditions of this country. Bartlette<sup>7</sup> reported the soil poor and the grass scanty along the Concho and between the Concho and Pecos. "A miserable barren region" extended for 65 miles along Pecos. There were patches of good grass near Guadalupe. From Indianola to San Antonio there was abundant grass, but from the headwaters of the Concho "begins that great desert region which extend a thousand miles and is wholly unfit for agriculture." In Vol. II, p. 4 of the same report T. H. Webb, speaking of the Gila and Colorado country and thence to San Diego, says: "Much is said by travelers respecting the desert

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<sup>1</sup> The Oregon Trail, Eighth Ed., pp. 59 and 65

<sup>2</sup> Loc. cit., p. 75.

<sup>3</sup> Loc. cit., Vol. II., p. 41.

<sup>4</sup> Voyage to the Northwest Coast of America, 1811-1814, pp. 111 and 265.

<sup>5</sup> Survey of Montana, etc., 1871, pp. 27 and 30.

<sup>6</sup> Loc. cit., p. 202.

<sup>7</sup> Loc. cit., Vol. I., pp. 86, 100, and 139.

of Sahara; but in barrenness of verdure, destitution of water, tremendous storms of sand, etc., etc., it is doubtful if any tract of land can surpass the jornada which we crossed. Indeed much of this country, that by those residing at a distance is imagined to be a perfect paradise, is a sterile waste utterly worthless for any purpose than to constitute a barrier or natural line of demarcation between two neighboring nations." In 1853, E. F. Beale found good grazing in many parts of New Mexico. Emory<sup>1</sup> reported concerning the Gadsden Purchase that the level areas were "usually covered with a luxuriant growth of nutritious grasses." "There are also to be found here, in the remains of spacious corrals and in the numerous wild cattle and horses which are still seen in this country, the evidence of its immense capacity as a grazing country . . . Wherever water is sufficient this whole region presents marvelous advantages for the raising of stock." Some parts of the Gila country were barren while other parts furnished good grazing.<sup>2</sup> Gregg<sup>3</sup> states that from New Mexico "during the most flourishing times (previous to 1835) as many as 500,000 sheep were exported in one year."

Ives<sup>4</sup> reported no grazing in the vicinity of Fort Yuma. The first grass camp found in ascending the river was near Explorer's Pass. The Mojave Valley was observed to be well grassed in the spring. Marcy<sup>5</sup> found "a heavy growth of the very best grass" along the Little Wichita. Mesquite grass was abundant along the Big Wichita. The valley of Otter Creek and the Wichita Mountains were abundantly covered with grass. J. F. Meline<sup>6</sup> found that in New Mexico "the high mesas or table-lands, indefinite in extent, furnish illimitable pasturage of the best description." Pike,<sup>7</sup> referring to New Mexico, says that aside from the valleys "all the rest of the country presents to the eye a barren waste of poor land, scarcely to be improved by culture." "Even the herbage appears to be poisoned by the mineral qualities of the soil." Texas, however, was considered

<sup>1</sup> Loc. cit., Vol. I., pp. 93, 94.

<sup>2</sup> From Fort Leavenworth to San Diego, 1846, 1847, p. 105.

<sup>3</sup> Loc. cit., Vol. I., p. 189.

<sup>4</sup> Report Upon the Colorado River of the West, 1857, 1858, pp. 42-66.

<sup>5</sup> Loc. cit., pp. 6, 23, 79, and 80.

<sup>6</sup> Two Thousand Miles on Horseback, 1867, p. 165.

<sup>7</sup> Loc. cit., Appendix to Part III., pp. 5 and 31.

"one of the richest, most prolific, best watered countries in North America." Sitgreaves<sup>1</sup> states that along the Zuni River "only two kinds of grass were found at long intervals and in small quantities; a tall coarse variety growing in large tufts, and a smaller kind having a perceptible incrustation of salt upon the leaves." Venegas<sup>2</sup> says that there were fine pastures westward from the Colorado River in 1730. The region along the border of Mexico and Lower California, however, is said to be the "most disagreeable, barren, and wretched country in the world." R. H. Forbes<sup>3</sup> contends that the ranges of the Southwest, according to the statements of stockmen, were in excellent condition in 1870 and have been greatly injured by overgrazing since that time. Bell<sup>4</sup> remarks concerning the Colorado Basin that "Complete barrenness is the rule, fertility the rare exception; scarcely any vegetation."

*Utah and the Great Basin.* Father Escalente<sup>5</sup> found a "flat meadow land" near Utah Lake, and reported that "throughout the whole there is good and abundant pasturage." Simpson<sup>6</sup> found excellent grass in Pleasant, Antelope, and Spring Valleys, while Butte Valley bore nothing but sagebrush and Reese River Valley was "divested of vegetation." According to Wheeler,<sup>7</sup> in western Utah and southeastern Nevada "the rich, succulent bunch-grass has been found most valuable for stock raising and the areas suitable have been already largely if not entirely utilized for this purpose." Of 175,000 square miles surveyed, 4.77 per cent was considered agricultural, 49.37 per cent grazing, 26.94 per cent timber, 16.95 per cent arid, 1.01 per cent water and swamp, and 0.96 per cent chaparral. "In 1871 but little of the arable or grazing land had come into the market in Nevada . . . It is not difficult to see that before many decades every useful acre will be appropriated . . . when there will still remain. in the hands of the general government

<sup>1</sup> Zuni and Colorado Rivers, 1853, p. 22.

<sup>2</sup> Loc. cit., Vol. I., p. 27.

<sup>3</sup> Forester, Vol. VII., p. 217.

<sup>4</sup> Loc. cit., Vol. I., p. xlvi.

<sup>5</sup> Journeyings from Santa Fe to Utah Lake, 1776-1777.

<sup>6</sup> Explorations in the Great Basin of the Territory of Utah, 1858-1859, pp. 54, 79.

<sup>7</sup> Geographical Surveys West of the 100 Meridian, 1869, pp. 17-37.

sterile wastes of tens of millions of acres." The term "Great American Desert" is used by Wheeler to signify the Great Basin. Bell<sup>1</sup> found that in the Great Basin "sage brush and greasewood alone spring from the parched earth, except where some stream . . . supports a few acres of grass."

*Wyoming.* During the early days of western mining and agricultural settlement a constant stream of travel passed through southern Wyoming. This is the least attractive part of the State and consequently many unfavorable comments have been made concerning it by the early travelers. Barnes<sup>2</sup> says that "25 miles east of the North Platte commences the desert in earnest. From the Platte west to Fort Bridger, 200 miles, is one almost uninterrupted panorama of barren hills . . . and bleak desolation. . . . Except at Pine Grove, a little oasis, I did not see a half acre of good, bad, or indifferent grazing all this distance." Fremont<sup>3</sup> in 1842 found scarcely any grass or vegetation near Bitter Creek and in the neighboring country. The Indians, however, told him they usually had little difficulty in finding grass for their horses here. Hayden<sup>4</sup> states that from Fort Bridger a desert extends eastward for 200 miles. The Laramie Plains were "covered with a thick carpet of grass." Splendid grass was observed westward from Laramie. According to W. A. Jones,<sup>5</sup> from Fort Bridger to Popo Agie River "the grazing land everywhere around is very fine." From the Popo Agie to Owl Creek Mountains there was little grass. From that point to the head of Gooseberry Creek there was good grazing. On the North Fork of Stinking Water there was "very little grass except a very tall coarse kind." "The western extremity of Wyoming . . . from the southern to the northern boundary . . . is as a rule semibarren . . . and supports a scanty growth of extremely nutritious grasses." In the Green River Basin "bunch grass grows sparsely among the sagebrush." The Laramie Plains were "thinly covered with grass while the valleys of the streams afford excellent pasturage."

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<sup>1</sup> Loc. cit., Vol. I., p. lix.

<sup>2</sup> Loc. cit., p. 49.

<sup>3</sup> Loc. cit., p. 70.

<sup>4</sup> Survey of the Territories, 1870, pp. 35, 47, and 123.

<sup>5</sup> Reconnaissance of Northwestern Wyoming, 1873, pp. 10-52.

The Wind River Mountain slopes were covered with grass, while the Big Horn Basin was "generally barren except the narrow belts along streams." Raynolds<sup>1</sup> found the Powder River valley to be a barren country. Bonneville<sup>2</sup> also refers to southern Wyoming as generally barren. P. St. Cooke,<sup>3</sup> referring to the country between South Pass and Ft. Bridger, says "The mules for once were ordered to be tied at the wagons; they gnawed and destroyed four wagon tongues, a number of wagon covers, ate their ropes, and getting loose ate the sage fuel collected at the tents; some of these (tents) they also attacked . . . . The earth has a no more lifeless, treeless, grassless desert; it contains scarcely a wolf to glut itself on the hundreds of dead and frozen animals," etc.

*Present conditions.* To one who is familiar with the present range conditions of the arid west as a whole, or any particular section of it, these statements must indicate a striking similarity in the appearance of the range in former times and at present. The relatively barren areas of the Great Basin, Southern Wyoming, and the extreme Southwest of the country as well as those of the southern part of Idaho were present in about the same extent and same condition at the time of the visits of various explorers as at present. So far as the numerous statements which have been consulted indicate, the general conditions and appearance of the range country have changed but little since the time when they were first explored by white men. As just indicated the barren areas mentioned by the early explorers are likewise the barren areas of the present, and the comparatively fertile regions of tall and abundant grasses are still distinguished by these characteristics. We may take Arizona and New Mexico as representing the Southwest. These territories have, in the opinion of some investigators, deteriorated most with regard to grazing conditions and the possibility of animal industry. Circular letters sent to a number of representative stockmen in Arizona elicited replies which indicate a striking

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<sup>1</sup> Loc. cit., p. 8.

<sup>2</sup> Loc. cit., Vol. I., p. 61.

<sup>3</sup> Utah Expedition 1857, U. S. House Representatives 35th Cong., 1st Session, Ex. Doc. 71, pp. 98, 99.

deterioration in range conditions.<sup>1</sup> The feed on the range in Arizona has evidently undergone certain changes in character during the past 20 years, as evidenced by the statements of stockmen and the investigations of Griffiths and others; nevertheless the total number of stock has not diminished in recent years to an extent which would indicate an alarming destruction of the range throughout the whole territory. Between 1895 and 1900 the number of horses in the territory increased from 56,000 to 125,000 and the number of sheep from 746,000 to 924,000. The number of cattle, however, diminished greatly and the majority of complaints with regard to the present conditions of the range in Arizona come from cattle raisers. The latest reports of the governor of the territory indicate a marked decrease in the number of cattle for the last 10 years and this is ascribed to a shortage of water and range feed. The sheep industry, however, is perhaps in a better condition than ever before and few complaints, which would indicate any striking deterioration in the range grasses are made by sheepmen. M. A. Otero<sup>2</sup> states that in New Mexico "the range is not being destroyed. The actual area used for grazing purposes supports the same number of head of stock now as in past days. The difference arises in that instead of belonging to a few companies, the stock is the property of a hundred owners." The live-stock business, including the raising of cattle, is said never to have been in better condition than at present, and range grasses are reported as abundant. It is evident, however, from the investigations of Griffiths<sup>3</sup> that the range in many parts of Arizona is becoming less and less productive, on account of overstocking and the consequent prevention of reseeding, which leads in turn to excessive erosion of the soil. These factors have brought about exceedingly discouraging conditions in some parts of the territory.

The present forage conditions of the northern border of the Great Basin are well described by Griffiths.<sup>4</sup> Three forage zones may be recognized in this region, viz.: Low lands, such as

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<sup>1</sup> U. S. Dept. Agr., Bureau of Plant Industry Bul. 4, pp. 4-14.

<sup>2</sup> Rpt. Governor New Mexico for 1902, p. 15.

<sup>3</sup> U. S. Dept. Agr., Bureau of Plant Industry Bul. 4.

<sup>4</sup> U. S. Dept. Agr., Bureau of Plant Industry Bul. 15.

river bottoms and low basin-shaped depressions; high plateaus; and the foothills and slopes at elevations intermediate between these 2 zones. The low lands are not generally used for grazing purposes but serve to furnish native hay. The mesas furnish a considerable variety of perennial grasses, such as blue grass, sheep rescue, wheat grass, etc., together with sage brush and other shrubs. The intermediate zone is of a rougher character and yields little except sage brush and shrubs of various sorts. The grazing conditions in Nevada and the possibilities of sheep raising have recently been discussed by Kennedy and Doten.\* The range grasses on the Sierra Nevada Mountains were found to be not greatly injured by overstocking. The forage plants were as a rule of a hardy nature and so abundant as to furnish plentiful grazing. It is suggested by these authors that the range could be improved by resting or by seeding with native grasses, but no particularly alarming destruction of grass was observed.

The present condition of the Great Plains is essentially the same as that described by early travelers. The prevailing grasses are still the buffalo and grama, of low habit. The sod formed by these grasses is comparatively close and the amount of forage produced is very great. The greatest difficulty in utilizing the immense grazing facilities of the Great Plains is the lack of water at sufficiently short intervals, and this difficulty is being overcome by the use of artesian wells and wind mills or gasoline engines attached to ordinary pumps. The immense numbers of buffalo in early days and later of cattle have not been sufficient to produce any marked change in the character or amount of range forage upon this area.

As representative of the Rocky Mountain States we may select Montana, Idaho, Wyoming, and Colorado. The development of the cattle and sheep industry in the northern parts of this region is comparatively recent, for the reason that this country was long supposed to be too far north for successful cattle or sheep raising under range conditions. The eastern two-thirds of Montana is largely devoted to grazing and has been since the earliest settlement of the State. There are im-

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\* Nevada Sta. Bul. 51.

mense areas along the eastern boundary of the State which still produce grasses from 10 to 16 inches in height and of sufficient thickness to furnish a fairly good crop of native hay, without the necessity of irrigation. This region, according to the testimony of early stock raisers, has remained without any decided change, in so far as forage conditions are concerned. The Judith Basin and the region around Sun and Dearborn Rivers have evidently always been excellent grazing ground since the earliest available reports. Opinions differ somewhat as to the actual height and abundance of the grass in various parts of this region, but the most reliable data and statements by living stockmen fail to indicate any pronounced change in the character of the range. A few stockmen assert that the grass in Judith Basin in the early 70's grew to a height of 2 or 3 feet and that the change to the present condition of short close-grown grasses, chiefly grama grass, took place after the introduction of sheep into this region. These statements, however, are incompatible with the statements of travelers who found uniformly excellent grazing throughout that part of Montana, but report that the grasses, even in Judith Basin, were short and that the ground appeared at first sight to be comparatively barren except along the river bottoms. As stated above, Thomas in 1871 reported Montana as being the best grazing State in the Union and, all things considered, this is perhaps still true at the present time. It is interesting to note, from a careful reading of the travels of Lewis and Clark, that almost without exception the regions where they reported short grass (grama grass) are still covered with these grasses, and that the same statement may be made for the locations on which they found taller and coarser grasses.

With regard to Wyoming the grazing conditions are almost the same at present as they were in 1870. The Big Horn Basin was then reported as comparatively barren and furnishing only short, dry grass, except along the streams. This is strictly true at the present day, and has been essentially the same since the memory of the oldest living stockmen in that region. The southern part of Wyoming, especially the Red Desert, gives today the same impression of barrenness as it did to the early travellers. The productiveness of this region, however, is well

understood by sheepmen, who lease the land for grazing purposes and who find that the productivity of the Red Desert is greater now than it was twenty years ago, despite the fact that it serves as a range for not less than 500,000 sheep in winter.

Davy,\* investigated the range conditions of Northwestern California, with special reference to the possible changes which the range had undergone as a result of overgrazing. While definite data concerning the former condition of vegetation in that region were not obtained, it is considered by this author as certain that the quantity of valuable forage grasses has diminished considerably within the past fifty years as a result of overgrazing. Statements were obtained from stockmen which indicate that certain valuable perennial species of grasses have been practically killed out and replaced by species which were considered less valuable. The carrying capacity of these ranges, however, is still comparatively high.

*The effects of overgrazing.* While it is evident that the arid stock ranges are able to withstand the effects of excessive grazing for a considerable period and to recover quite completely, if allowed a suitable period of rest, it is nevertheless equally apparent that overstocking persisted in continuously for long periods brings about a condition of extreme barrenness upon range lands, and especially in the southwestern portion of the country where aridity and erosion are more pronounced. Various effects of overgrazing have been noted by different observers from time to time, and these observed effects have received more or less plausible explanations. The findings of different observers, however, with regard to the actual effects of overgrazing, and the arguments employed in proving the cause of these conditions are more or less contradictory and incompatible. On the one hand we frequently note the statement that the trampling of soil by the hoofs of sheep or other animals leads to an increase in the amount and rapidity of superficial run-off of water and consequent erosion. Other observers, however, argue that in order to prevent excessive superficial run-off and erosion it is necessary to loosen the soil to a greater or less extent. It is apparent that these two statements are directly

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\* U. S. Dept. Agr., Bureau of Plant Industry Bul. 12.

opposed and both cannot be true under the same conditions. Indeed the effect of trampling by the hoofs of animals varies greatly according to the nature of the soil and the amount of moisture. In loose, sandy soil the sod may be easily broken by the trampling of animals, even in a dry season, while similar trampling on hard clay soil ordinarily serves to pack the soil down into a still firmer condition, and thus increases the rapidity of superficial run-off after rains. It is thus perfectly apparent that the effect of the trampling of animals upon the range is not uniform. In some instances it may be beneficial and in others extremely injurious. On steep slopes, especially in sandy soil, large portions of sod may be torn loose and the erosion of the sand greatly increased. The roots of seedling trees may also be injured or exposed by the same agencies. The worst effects of the trampling of animals are observed where the animals are herded too closely and allowed to form trails upon steep slopes, which subsequently serve as water ways for carrying off the excess of water after heavy storms. The bad effects of trampling are also observed when sheep camps are maintained in the same place for too long a period upon the summer range. The grass is then entirely destroyed in the region of the camp, and even the roots are injured by the excessive trampling.

The action of the hoofs of animals upon the grass and sod is thus seen to depend greatly upon the management of the stock. If sheep or other animals are held in one place for a long period the effect of trampling becomes pronounced. The ground may be completely divested of vegetation, and even the grass roots may be killed. Under a rational system of management, however, these effects are not manifested. Excessive trampling by cattle and horses may pack the superficial layer of soil so firmly as to render it comparatively impervious to water. Erosion and superficial run-off of water are closely interrelated. Whatever increases the rapidity of superficial run-off will naturally tend to increase erosion. On firmly packed soil, however, covered with close short grass a very rapid run-off may be associated with an almost complete absence of erosion. The water appears to run over the fine grass without carrying away any of the soil. Tall coarse grasses prevent the rapid run-off of water,

and as a result the water enters the soil and therefore does not cause erosion. The protection afforded by a good cover of grass on the ground is especially conspicuous on steep mountain slopes. During a torrential storm the grass is bent over and almost entirely prevents the erosion of soil, while barren soil is eroded with great rapidity. The importance of protecting steep slopes against overgrazing cannot be urged too strongly upon the attention of stock raisers. During a trip through northwestern Wyoming abundant opportunity was had for observing the relation between excessive grazing and erosion on steep slopes. During the year 1900 the grass between Sunlight Creek and Crandall Creek along Clark's Fork of the Yellowstone had been closely grazed by sheep. During the season of 1901 after the occurrence of a number of heavy rain storms Clark's Fork was very muddy as the result of a large amount of fine soil particles carried down from the mountain slopes. In some localities large flat areas near the canyon of Clark's Fork were covered with silt to a depth of from one-half to two feet as a result of these storms. Above the point where sheep had been allowed to graze during the previous season the river and tributary streams were found to be perfectly clear immediately after the heavy rains which had caused the muddy condition of the river farther down. The grass in the region which had not been grazed was much taller and had resisted the rapid run-off of the water to such an extent that the river was not unusually swollen and no fine soil had been carried into it.

In New Mexico, E. O. Wooten has observed that on ranges which have been overgrazed with cattle and horses the soil is apt to become cut up with deep ditches which develop from the trails caused by these animals. The appearance of the country is thus considerably changed and the aridity is apparently increased as a result of the facility afforded by these ditches for a more rapid run-off of water. According to the same author the effect of overgrazing by sheep is not manifested in increased erosion or the production of arroyos to any great extent. If the high mountain meadows are closely grazed the soil is exposed to the action of the violent thunder storms which occur from time to time and erosion is thereby greatly increased in the meadows

themselves and upon the lower-lying slopes as a result of the more rapid run-off of water.

The destruction of grasses and the replacement of certain species of grass by other species or by weeds are phenomena which are manifested to different degrees, dependent upon the kind of animals, the nature of the soil, and the dryness of the season. Great differences of opinion are observed in studying the published results of investigations thus far made on this subject. In some localities it is claimed that excessive or even moderate continuous grazing by sheep or cattle has a tendency to destroy native grasses of the range and to permit their replacement by less desirable species or by weeds. In some instances it is claimed that the perennial grasses are rapidly destroyed and replaced by annuals, while in other localities the annuals are said to be destroyed first by grazing, and to be gradually replaced with grama and buffalo grasses; the latter two grasses appear, according to the testimony of early explorers and modern investigators as well as according to the observation of stockmen and from the present condition of the range, to be perhaps more capable than any other species of grass of withstanding arid conditions, excessive grazing, and trampling. It is difficult to understand how perennial grasses can be destroyed more easily than annuals. Annual grasses must reseed themselves each year in order to maintain an existence upon the range, while the perennials may live for a number of years, even if prevented from reseeding. Observations, however, made by Davy in California and by Wooton in New Mexico indicate that this process takes place under certain conditions. \*It is claimed by stockmen in Sherwood Valley, Cal., that in 1853, *Danthonia californica*, a valuable perennial grass, was the most abundant species upon the range; it is now said to be almost extinct. Similarly, several other species of perennial grasses in California have gradually succumbed to sheep grazing. Small barley grass, soft chess, and squirrel-tail have been introduced into California since 1865 and have replaced native species of grass. It appears from an examination of the ranges of northwestern Cal-

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\* U. S. Dept. Agr., Bureau of Plant Industry Bul. 12, pp. 19-35; New Mexico Station Press Bul. 78.

ifornia, that the dominant species of grass have changed several times during the past twenty years. It is commonly believed, although the reasons for this belief are not very evident, that the original species of grass were more nutritious than the introduced species. In New Mexico the native perennial grasses of certain localities have been replaced to some extent by annual grasses, which are claimed to be of inferior feeding value and also to be distasteful to stock. Georgeson also observed this process on an overgrazed prairie area in Kansas<sup>1</sup>; the native grasses were apparently dying as a result of overgrazing, and were being replaced by undesirable grasses and weeds. In southwestern Oregon Griffiths<sup>2</sup> observed several injurious effects of sheep grazing. Sheep fescue was completely killed by overgrazing, even large bunches of this grass being absolutely destroyed. This result was partly due to too close cropping, with the resultant exposure of the bunches of roots to the direct rays of the sun and the diminished power of these bunches for holding moisture, as well as to the pulverizing action of the hoofs of the sheep, which are kept almost constantly in motion in fighting flies and in moving about during the resting period in the middle of the day; the surface of the soil was thus reduced to a fine powder and the superficial roots of grasses were much cut to pieces.

One readily observes, in studying the habits of animals upon the range, that a more or less pronounced choice is exercised in the selection of forage plants. The plants preferred by cattle and horses are not necessarily those which are most liked by sheep, but a preference is manifested by all of these animals, and this results in the close grazing of the preferred plants while the less desirable grasses and certain weeds may be allowed to grow. This process, however, is not so simple as might be supposed from such a statement. No great regularity is apparent in the choice exercised by different domestic animals and when a desirable species becomes comparatively scarce, less desirable and more abundant species are grazed, with the result that the range when stocked to its full capacity is grazed almost

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<sup>1</sup> Kansas Sta. Bul. 48, p. 43.

<sup>2</sup> U. S. Dept. Agr., Bureau of Plant Industry Bul. 15, p. 29

uniformly with regard to nearly all its forage plants. It is only while the forage is abundant and the range not too heavily stocked that animals wander about to a great extent in search of certain preferred species of forage plants. Ranges occupied with annual grasses are easily injured by excessive grazing, on account of the habit of shallow rooting which is almost universal in these species, and on account of the fact, already mentioned, that they must reseed each year in order to maintain their place on the range. There are other species of so-called weeds which are eaten at some seasons of the year, especially by sheep, and since few of these plants withstand excessive grazing so successfully as grass, there is as a rule no pronounced tendency toward the replacement of grass by weeds, except on ranges which are manifestly overstocked and where weeds which are quite inedible to stock secure a foothold.

C. H. Bayless, an Arizona stock grower, as a result of fifteen years' experience in that territory<sup>1</sup> maintains that the grama grasses have gradually diminished in quantity during the past two years and that certain annual grasses which have partly replaced them are of little value. It is believed by this stockman that the carrying power of the Arizona ranges has been greatly diminished and that this is due entirely to overstocking.

R. N. Sutherlin<sup>2</sup>, in speaking of the ability of bunch grass to endure heavy pasturage, makes the following observation: "In 1865 the hills around Virginia City were grazed off perfectly bare for a distance of six or seven miles in every direction and many asserted that in a few years it would be a barren waste. Today those hillsides support as luxuriant a growth of feed as they did previous to the habitation of the country by whites." Toumey<sup>3</sup> states that on the eastern slope of the Rocky Mountains grama and buffalo grasses formerly prevailed, but that these grasses are now replaced by less valuable species. This statement, however, is directly contradicted by many others. It is apparent, even to a casual observer, that throughout the larger portion of the Great Plains the reverse condition is true, viz., that grama and buffalo grasses have almost entirely

<sup>1</sup> U. S. Dept. Agr., Bureau of Plant Industry Bul. 4, p. 13.

<sup>2</sup> Loc. cit., p. 23.

<sup>3</sup> Arizona Sta. Bul. 2.

displaced all other species. This process was almost completed at the time of the earliest western explorations and has continued in force until the present day. T. A. Williams<sup>1</sup> maintains as a result of his investigations on the range conditions in the northern portions of the Great Plains, that "out on the open ranges of the plains, however, there are few localities in which the pasturage is anything like as good as in former years. Leading stockmen from nearly all parts of the plains region estimate that the stock-carrying capacity of the pasture land has been reduced on the average from 40 to 50 per cent in the last ten or fifteen years." This statement, however, does not represent the conditions which prevail throughout the Great Plains as a whole, since the scarcity of water has rendered it impossible to utilize all the grazing ground of this region. The recent development of the use of wind mills and gasoline pumps as well as the location of artesian wells, has made accessible large areas of this region which were previously but little grazed. The grass is reported to be in excellent condition on these ranges.

With regard to the comparative effects of overgrazing by cattle and sheep, these questions will be discussed in connection with the description of the industries of cattle and sheep raising. Injuries to the range grasses from overgrazing are usually attributed by cattlemen to sheep and by sheepmen to cattle. The unqualified statements which are so frequently made on this subject have, therefore, to be interpreted in the light of special prejudices which may be entertained by the observer. H. M. Taylor<sup>2</sup> asserts that sheep "travel but a few miles a day, and leave the country over which they pass as bare of grass as the house floor. . . . Utah is full of sheep and hundreds of thousands are started every spring to the eastward . . . spreading out over the range in all directions like a swarm of Egyptian locusts." "My observation for several years of the nomadic sheep raiser causes him to be placed in the category of a nuisance." The same author came to the conclusion that in 1885 the ranges were overstocked and every acre throughout the arid belt was already occupied. The general depression in the cattle

<sup>1</sup> U. S. Dept. Agr., Division of Agrostology Bul. 12, p. 51.

<sup>2</sup> U. S. Dept. Agr., Bureau of Animal Industry Rpt. 1887-8, pp. 122, 330.

business which took place at that time is attributed partly to the alleged overstocking and destruction of the range. Wheeler<sup>1</sup> contends that "The sheep have made savage work with the rounded hills . . . by treading out the natural grasses." In a letter to the Secretary of the Interior, February 14, 1883, C. M. Howard<sup>2</sup> makes the following statement with regard to conditions in Utah: "In the course of three or four seasons where sheep have been herded they literally kill out every green thing. . . . Five years ago the valleys and foothills for twenty miles hereabouts were covered with a heavy growth of bunch and grama grasses. Today there is scarcely a shrub left—nothing but straggling bunches of sage brush." This stockman relates that in 1876 there were thousands of acres near Beaver City covered with grass waist high, and that this same area is now quite barren.

Upon careful investigation of the grass problem, however, in any given locality it soon becomes apparent that the effects observed as the result of the overgrazing of one season may be only of a temporary nature, and that while the range may appear to be left in a barren condition after the stock is removed, these same conditions may nevertheless have prevailed essentially unchanged ever since an accurate knowledge of the western grazing lands was obtained. The failure to recognize the great natural powers of recuperation of the arid range country has led to many unjustifiable assertions regarding the destruction of the range grasses. Thus Roth<sup>3</sup> calls attention to this point in the following words: "It is a common error to mistake a short-cropped range for a poor or injured one. Some of the older ranges, like the Red Desert of Wyoming, were on this account supposed to be all killed out more than fifteen years ago, and yet these very same ranges support as many sheep as ever and support them fully as well. Similarly, parts of the Cascades have been used, and used hard, for many years, but in spite of being closely cut and in spite of the fact that the tall bunch grass has long disappeared, the bands do as well as ever."

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<sup>1</sup> Geographical Surveys West of the 100th Meridian, 1889.

<sup>2</sup> U. S. House Representatives 50th Cong., 1st Session, Ex. Dec. 232, p. 3.

<sup>3</sup> U. S. Dept. Agr Yearbook 1901, p. 346.

Nelson\* also describes the forage conditions of the Red Desert of Wyoming. According to this description there is at present excellent forage in this region, and horses, cattle, and sheep do well upon it. During the winter more than 500,000 sheep are grazed upon the Red Desert. It has been found that the quality and quantity of forage on this area is not only quite satisfactory but that it is actually improving. An area which twenty years ago would support only one sheep is now capable of subsisting three to five sheep. The railroad land in this region is leased by sheepmen, who gladly pay the usual leasing price in return for the forage which they obtain. As already indicated, however, there are few regions which appear more unattractive than the Red Desert or which would be more likely to be chosen by a superficial observer to illustrate the effects of overgrazing.

No attempt has thus far been made in this discussion to define what is meant by overgrazing. The most satisfactory meaning to ascribe to this term is that of an extent of grazing which, when persisted in for long periods, will gradually lead to the deterioration of the range conditions. A moderate amount of grazing may be taken as meaning an amount of grazing which can be persisted in indefinitely upon a given range without causing any such deterioration in the grass. The effects of moderate grazing upon ranges or in forest reserves is apparently no more injurious than the removal of a crop of grass annually by means of a mowing machine. The question of whether the range grasses are being exterminated or being displaced by less desirable species and weeds can only be determined after careful observations extending over a period of years.

In forming a critical judgment of the value of testimony regarding range conditions in any locality attention should be given to the effort, or lack of effort, on the part of the observer to examine parts of the range which exhibits average conditions and to avoid basing his opinion upon conditions which prevail along highways and sheep or cattle trails. It is apparent, even to a casual observer, that the grass on the usual camping grounds along the main thoroughfares in the range country is ordinarily

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\* U. S. Dept. Agr., Division of Agrostology Bul. 13, pp. 22-24.

much more closely grazed than that which is found farther from the main line of travel or away from the usual camping places. Horses which are picketed or turned loose upon the usual camping grounds destroy the grass very effectively within a short time. Thus J. H. Dickerson<sup>1</sup> relates that after they had been in camp on good grass only a week the grass had been eaten for a distance of one and a half miles in all directions. Blackinship<sup>2</sup>, in referring to the observed evil effects of overgrazing, states that this is particularly manifest along "the main lines of travel pursued by the different bands of sheep and in the vicinity of shipping points and shearing corrals." Such conditions would naturally be expected, but they cannot be considered as indicating in any way the average conditions upon the range. The same author refers to the great power of resistance against excessive grazing possessed by such grasses as bluejoint, grama, and buffalo grass. These grasses have, as already indicated, maintained themselves in essentially the same conditions for long periods in various parts of the range country, and especially the grama grass appears to attain as great a height upon the mountain ranges as in former years before the numbers of sheep and cattle were of great significance.

*Range improvement.* Various schemes have been proposed for the improvement of the western ranges and the more important of them may be properly discussed in this connection. In order that grasses may reseed themselves successfully it is desirable that the superficial layer of the soil be not packed down so tightly that the seed can not find lodgment. Under certain conditions the loosening of the soil is brought about by the trampling of the sheep, cattle, and horses. Where this does not take place it may be desirable under certain conditions, and perhaps only on a small scale, to run over the range with a light disk harrow. This is especially desirable where deliberate attempts are made to improve the range by sowing grass seed. The seed should preferably be sown previous to harrowing and at a time of year when some rainfall may reasonably be expected. The grasses which should be selected for improving the range by

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<sup>1</sup> Utah Expedition, 1857, p. 100.

<sup>2</sup> Montana Station Rpt. 1902.

artificial seeding are, according to the experiments thus far made, the native species. The native grasses appear to be best acclimated to the aridity and other climatic conditions of the range and therefore thrive better than any introduced or cultivated species. Certain grasses especially adapted to semiarid conditions thrive fairly well if favorable conditions exist during the first year. The awnless brome grass is perhaps the most noted of these species, but the experiments made with this grass in Montana under natural range conditions have not shown that it is capable of maintaining itself in a satisfactory condition. Where some moisture becomes available through seepage the brome grass starts early in the spring and furnishes green forage, which is especially desirable for ewes. The most satisfactory results, however, are to be expected from the collection and sowing of the seed of the most valuable native species, such as grama grass, buffalo grass, bluejoint, etc. These species have maintained themselves, under more or less adverse conditions, since the earliest knowledge of the western ranges, and may be reasonably expected to give good results in the future. They are, moreover, exceedingly nutritious and are well liked by all kinds of stock. It may be doubted whether, under present conditions, the sowing of any seed upon the open range will become a general practice. The expense is too great to justify the operation on the part of any stockman so long as he has no assurance that the benefits of his work will not accrue equally to other stock raisers who may lay claim to the range. Under a leasing system or upon grazing ground owned by stock raisers such improvement would appear to be more fully justified from a financial standpoint. Evidently the natural method of grass reproduction is to be preferred, on account of its effectiveness and also from financial considerations. So long as sufficient care is exercised to prevent all of the grass from being eaten during any one season, a portion of it forms seed and will serve to reseed the range and prevent any marked deterioration in the quantity of forage. The native grasses upon the ranges are capable of being sustained by a minimum amount of moisture, and after being thoroughly dried up, root and stem, during the dry season, they are capable of starting up quickly under the influence of showers.

If these required conditions for the reproduction of native grasses are not observed a failure to reseed occurs, with the consequent gradual diminution in the amount of forage upon the range. When this process has taken place to a pronounced degree it becomes necessary to give such areas a rest, either for one or more years or for a portion of each year. Alternate grazing and resting of the range corresponds exactly with the conditions which prevailed before the advent of the western settlers. The buffalo traveled about from one part of the range to another, and large herds carried out general seasonal migrations northward in the spring and southward with the approach of winter. This brought about the alternate grazing and resting of various parts of the range quite as effectually as can be produced by the artificial management of stock. While the grass was apparently quite destroyed by the grazing of buffalo, the rest which was afforded for the remainder of the season after the migration of the buffalo was sufficient to enable the range to recover. Stockmen as a rule divide the areas at their disposal into summer and winter range, and it has been found that this system is not only convenient, in so far as the management of stock is concerned, but also has the great advantage of preserving the range with a minimum amount of injury to the grass. The grass is thus allowed to produce seed during the season when it is not grazed, and the native species are preserved in as nearly as possible their original relative importance. Resting the range for a greater period than one season may prove very inconvenient for many stockmen with limited range at their disposal. Where, however, it is observed that the condition of the range grasses is gradually deteriorating, it is necessary to allow some period of rest, or to reduce the number of stock. An abundance of experience along this line has demonstrated that a short rest is sufficient to produce a great increase in the amount of forage and to greatly improve the general conditions of the range. It has been shown by experiments on a small and large scale that the recuperative powers are marvelously great. This constitutes the chief basis of hope for the range cattleman and sheepman, and he may reasonably expect that the range will recover from the effects of abuse, such as overstocking, after a short period of rest.

The control of grazing land which is leased or owned by individual stockmen is a simple matter. The areas in question are fenced in order to prevent the encroachment of outside stock and the number of stock allowed to graze upon the inclosures may be regulated according to the observed conditions of the grass. Fencing is thus an effective and not excessively expensive method of solving the grazing problem. This remedy, however, is evidently not applicable upon the public range. In this connection it may be desirable to refer briefly to the results of certain experiments and observations which have been made regarding the improvement of the range. Bentley<sup>1</sup> concluded as a result of his observations that the range can be greatly improved by light harrowing, resting, and sowing seeds of native grasses. It was estimated that the carrying capacity of certain range areas had been increased to the extent of 100 per cent within a period of three years by the application of these methods. As is well known, the range land of Texas is owned by the State and is largely fenced. In the earlier days of the cattle business in that State, according to the observations of stockmen, the grass grew to considerably greater height than at present. It has been estimated that thirty years ago in some parts of Texas 300 cattle could be kept on each square mile. This number, however, was too high for permanent stocking and the grass was greatly reduced in quantity as a result of overgrazing. Hon. J. M. Carey, in referring to the means for improving the range in Wyoming<sup>2</sup>, says "As soon as the cattle are removed the ranges again grow up to the native grasses." Georgeson<sup>3</sup> carried out an experiment on a prairie pasture which had been overgrazed and upon which weeds were growing up. Native grasses seemed to be on the decline. The surface of the soil was disked and a mixture of cultivated perennial grasses was sown. The cultivated grasses appeared to predominate until June, when the prairie grasses began to gain the ascendancy and by September the latter had displaced the cultivated grasses and weeds.

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<sup>1</sup> U. S. Dept. Agr., Bureau of Plant Industry Bul. 13, p. 34; U. S. Dept. Agr., Farmers' Bul. 72.

<sup>2</sup> U. S. Dept. Agr., Division of Agrostology Bul. 12, p. 10.

<sup>3</sup> Kansas Sta. Bul. 48, p. 43.

Nelson<sup>1</sup> recommends alternate resting and pasturing of the range, combined with the use of a disk harrow and reseeding with native grasses. J. G. Smith<sup>2</sup> calls attention to the fact that in Texas some stockmen seem to believe that the country was never grazed until sheep and cattle were introduced; it was therefore difficult to persuade them that the observed results of overgrazing in certain localities were not a new phenomenon but that similar conditions had prevailed from time to time as a result of the grazing of buffalo and wild horses. "The intermittent grazing and resting of the land resulting from the roving habits of the buffalo and mustangs was an ideal method of pasturing and improving the natural pasturage." Attention is also called by this author to the fact that after the destruction of the buffalo a short period intervened during which the cattle and sheep business was being developed and during which the number of domestic animals was quite insufficient to eat as much grass as had previously been consumed by buffalo. The native grasses therefore attained a height and thickness of growth which was considerably greater than the average, until they were grazed off during the days of the cattle kings in the 80's.

When we consider the immense areas of grazing lands upon which it is proposed to put in operation practical schemes for the improvement of the grazing conditions it is apparent that these schemes must suit the requirements of stock raisers under present conditions, or that before they can be put in operation certain changes must be made in the land laws. It would be of little avail to discuss in detail the present mooted question concerning the leasing of public grazing lands. No agreement has been reached on this point, either between legislators or between stockmen, who are most intimately concerned in the passage of such a law. It is argued on the one hand that in order to induce any stockman to make improvements upon the range it is necessary to give him control of the range for a considerable period of time; otherwise, it is argued, no one could be expected to lay out money for improvement so long as others may share equally in the benefits. The opponents of the leasing system

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<sup>1</sup> Wyoming Sta. Press Bul. 7.

<sup>2</sup> U. S. Dept. Agr., Division of Agrostology Bul. 16.

maintain, on the other hand, that any system of leasing will operate directly in favor of large cattle and sheep companies and against the interests of homesteaders. The only point upon which there seems to be unanimity of opinion is that any law for leasing the public range which will give an advantage to large stock companies and discourage the settlement and improvement of the land by homesteaders would militate against the best development of the western country. The advocates of a leasing system hope to be able to devise a plan by which the land may be leased without entailing the undesirable results which have just been mentioned. It is of interest to know that the general proposition of leasing the range has been the subject of a detailed discussion at the meetings of the National Live Stock Association, and that these discussions have shown that the stockmen themselves are about evenly divided on this proposition. In 1900 and again in 1901 the Association, after a prolonged discussion, voted not to recommend the passage of a leasing law. This question is at present kept before members of Congress by resolutions adopted in favor of such legislation or opposed to it. On this account the matter has assumed a legislative rather than a scientific aspect. It is perfectly obvious that certain evils, such as driving large herds of cattle and sheep from one part of the country to another in search of range, could be entirely avoided by a leasing system which would apportion the range among various stockmen and give each man control of his portion.

Until changes are made in the land laws, however, the remedies which are applied for the improvement of the range must be of a practical nature. It must be recognized that the ranges of the arid west cannot be made to perform miracles, such as the production of grass two or three feet in height, without the application of water, which in turn is a manifest impossibility over a large proportion of the range. The production of grass upon the range is limited by the amount of annual rainfall and, as already indicated, probably does not greatly differ at present from the earliest known conditions. So long as a half ton of grama grass, or other equally nutritious grass, is produced on each acre of grazing ground the average conditions may be said

to prevail and no reasonable complaint can be made. It is absurd to suppose, as has apparently been done by certain periodical and newspaper writers on this subject, that such simple remedies as disk ing and reseeding the range, combined with a reasonable amount of rest would lead to the production of larger quantities of forage than have ever been observed by stockmen. The soil of nearly all the western ranges is very fertile but the amount of grass produced is determined by the moisture present. It is therefore unreasonable to suppose that any great changes in the productive capacity of the range can take place so long as the present climatic conditions prevail. The practical remedies which have been suggested can not be expected to do more than maintain the productiveness of the range in a good average condition and without any permanent deterioration.

*Forest reserves.* Considerable interest has always been felt by certain statesmen and patriotic citizens in the preservation and economic utilization of our forests. This has led to the establishment of forest reserves in order to secure to the Federal Government control of the administration of the forests. The areas of timberland set aside as forest reserves have increased rapidly during the past few years, until at present the total area thus reserved has reached 195,000,000 acres. The immense value of these reserves, from the standpoint of the future production of timber, can not be overestimated, and the proposition which has been enthusiastically championed by many forest experts that all areas suitable for forest reserves should be set aside for this purpose must be considered as a judicious move in the right direction. For the purpose of this discussion, however, no attempt can be made to describe the forest reserves in detail. The value of forests as agents in the protection and regulation of the water supply in the arid regions has been adequately and frequently discussed in government documents, periodicals, and newspapers. Their agency in regulating the flow of water from the higher portions of the mountains can scarcely be doubted by any one. In this connection, however, we wish to call attention simply to the value of the forest reserves as grazing areas. It may be considered as a safe estimate that about 25 per cent of forest reserves, as at present established, is

grazing land. A certain proportion of the remaining 75 per cent is occupied by brush or small and scattering trees, and the grass which grows in such areas is also of some value for grazing purposes. Even in the most heavily timbered areas certain species of grass predominate which may be eaten by stock under certain circumstances, but are not usually well liked.

The establishment of forest reserves and their subsequent subjection to governmental control have led to differences of opinion concerning the proper policy of forest management. On the one hand the extreme rule has been laid down by certain writers that forest reserves should be given up entirely to the production of timber and that no grazing or agricultural industries should be allowed within their limits. The other extreme position maintained, especially by stockmen, is that all reserves should be opened up to grazing by all kinds of stock without any restriction whatever. As a result of the conflicting opinions held with regard to the utilization of forest reserves a commission was appointed in 1897 by the National Academy of Sciences to inspect the forest reserves, study the conditions of forest reproduction and grazing industry, and report upon a practical and reasonable policy for managing these reserves. The commission recommended the following policy for this purpose: "A study of the forest reserves in their relations to the general development and welfare of the country shows that the segregations of these great bodies of reserved lands can not be withdrawn from all occupation and use and that they must be made to perform their part. . . . Land more valuable for its mineral deposits or for the production of agricultural crops should be taken from the reservations and sold to miners and farmers." This commission, however, stated emphatically that the forest reserves must be considered as belonging to the whole country and should not be destroyed by a few miners, lumbermen, and stock raisers.

The present management of forest reserves is in the hands of the Department of Agriculture, in which Department a Forest Service has been organized as a continuation and extension of the Bureau of Forestry. The grazing of animals in forest reserves is made subject to the issuance of permits. Small

charges are made for these permits; the land is not leased in the ordinary sense, but is merely occupied temporarily during the summer season, under special permits from the Department of Agriculture. The number of animals, time of entrance and exit, the districts to be grazed, and the rules to be observed in the management of animals while in the reserves are determined by the Federal Government. The various forest reserves are examined from time to time for the purpose of determining the existing forest conditions and any bad effects which may have been produced by overgrazing in former years. The number of animals to be admitted to each reserve is determined in accordance with the reports made upon these examinations. The number of animals allowed in reserves naturally varies from year to year in accordance with the conditions already mentioned. In 1909, for example, 7,700,000 sheep and 2,400,000 cattle and horses were grazing upon the land of the government forest reserves. The time of entering the reserves varies in different parts of the country, from April to July, and the time of exit, from September to November.

The chief reason for discriminating against sheep grazing in so many of the reserves is to be found in the observed carelessness of herders in bedding their sheep for too long a period upon the same ground, and thus destroying the grass roots and greatly injuring seedling trees. Sheep herders have also been accused of setting fires for the purpose of clearing up larger tracts of grazing ground, and these accusations, although often unfounded and maliciously circulated, have served the purpose of keeping sheep out of certain reserves. It is not true that cattle and horses cause no damage in forest reserves, nor is it true that sheep are necessarily and invariably injurious. The amount of damage caused by cattle, horses, or sheep depends almost entirely upon the number per acre and on the method of managing them. The injury to seedlings and older trees from the browsing habits of animals evidently depends on the amount of other forage to be eaten, and consequently upon the extent of overstocking. In most localities the present system of control of grazing privileges in forest reserves has led to the improvement of the forage conditions in these reserves, to such an extent

that the native meadows are covered with an abundance of grass. These conditions can evidently be maintained so long as the number and management of the animals in the reserves is under proper control and the great amount of excellent grazing which is to be found in the forest reserves of the arid west will thus continue to be an important factor in the continuance of the prosperity of stock raisers, many of whom depend almost entirely upon the grazing areas in forest reserves for the maintenance of their stock during the summer season.

*Cattle raising.* The Spaniards introduced cattle and sheep into their earliest settlements in New Mexico, Arizona, California, and Texas. The long-horned Spanish cattle, more familiarly known as Texas cattle, the Spanish Merino and a breed of long-wooled sheep thus introduced by the Spaniards served as a basis for the cattle and sheep business on the range country for a long period of years. The early American settlers soon discovered the possibilities of cattle and sheep raising upon the ranges of the northern part of the arid west and introduced sheep and cattle as rapidly as circumstances would permit. At first the most serious obstacle to cattle raising was found in the depredations committed by Indians and carnivorous animals. As soon as the Indian troubles were settled by the establishment of reservations and the more or less successful confinement of the Indians to these tracts the cattle business progressed with great rapidity. The enormous profits which were made out of the range cattle business soon became known, not only throughout this country but in Europe, and cattle companies were formed, with the result that great sums of money were invested by German, English, and Scotch speculators. The management of cattle under range conditions without any attempt at winter feeding, especially on the large scale which prevailed in the early days of the cattle business, made it possible to carry on this industry at an exceedingly small expense. As soon as the ranges in certain localities began to be crowded by competition between different cattlemen and by the development of the sheep interests, the profits of the cattle business began to be somewhat reduced. This reduction in profits naturally served as a discouragement to the extension of the business and the

turn in the tide of affairs was hastened by the occurrence of severe winters and a series of unusually dry years. Thus in California unfavorable conditions in 1834 led to the slaughter of the majority of the mission cattle by the friars. The number of cattle reported from California in 1850 was 262,000, in 1862, 2,000,000, while in 1870 it was only 631,000. This great falling off in the number of cattle took place as a direct result of the disastrous droughts of 1862 to 1864. These dry years had the effect of breaking up the range cattle business and driving settlers into other lines of industry, such as sheep raising, dairying, and farming. Within a few years after 1860 the number of sheep in California increased sixfold. In other States similar changes took place, which will be discussed later.

The Texas cattle may be considered the original cattle of the western range business. They multiplied to such an extent within the confines of Texas that the markets furnished by New Orleans and the neighboring cities were quite inadequate to consume the annual surplus. There was therefore little market for Texas cattle for a period of nearly twenty-five years previous to the civil war. The prices of these cattle went down as low as \$1.00 per head. After the civil war the prospects of disposing of Texas cattle upon northern markets were very bright and a number of cattle raisers immediately ventured upon the new industry of driving Texas cattle northward. This business began in 1866, during which year about 260,000 head of cattle were driven out of Texas. The industry met with the violent opposition of the cattle raisers of Kansas and Missouri, on account of the fear of Texas fever, which was carried northward in the herds of Texas cattle. Notwithstanding this opposition, however, the cattle drovers of Texas carried on a fairly successful business for a number of years. Abilene, Kas., was established as a shipping point in 1867. The number of cattle annually driven into the northern States from Texas varied during the following years from 35,000 to more than 600,000.

It was soon found that, while the southern portion of the range country might be considered as the best breeding ground, animals raised in southern States could very profitably be driven north and fattened upon northern ranges. In experiments made

along this line it was shown that the animals could be brought to a greater weight on the northern ranges than they would ever attain if kept in the South, and that the cost of production was lowered. The cattle business of the northern ranges consisted, therefore, at first to a considerable extent in buying young Texas steers and driving them north to finish them upon the range.

While Texas cattle were evidently well acclimatized to the range and able to maintain themselves under unfavorable conditions with marked success, it was soon found that improved breeds were also capable of doing this quite successfully and of attaining a greater weight and more desirable form. It has therefore come about that these improved breeds have almost entirely replaced Texas cattle throughout the northern range country. The breeds which are preferred for this purpose are Shorthorns, Herefords, Angus, etc., and grades of these pure breeds. As is well known to all cattle raisers these animals develop the so-called beef form to a greater perfection than the Texas cattle, and consequently bring a higher price upon the market. It has also been shown that they can transform alfalfa and grain into beef more profitably than can the Texas cattle.

In the early days of cattle raising and in some parts of the country at present no winter feeding is done. Cattle are left to their own resources and are forced to find their own grazing upon the range. They naturally move about over greater or less extensive territory, and are found on one part of the range in summer and in other locations in winter. Cattle thus left to themselves upon the range soon learn the position of watering places and the most desirable grazing grounds for the different seasons. The cost of maintaining cattle under such conditions was not greater than \$1.50 to \$2.50 per head per annum. Under these primitive conditions of cattle raising some cattle companies made no attempt to inspect their animals except twice a year at the general roundups. The advent of the small farmer and the consequent withdrawal of the desirable farming land along streams from the area of grazing grounds rendered the dangers of wintering without feed continually greater and greater. The cattle ranges were also reduced by the development of the sheep business, until finally the apparently crowded conditions and

the great losses during the winters of 1881-2 and 1885-6 demonstrated emphatically the desirability of providing winter feed for range animals.

The number of animals owned by single companies and the amount of territory controlled by these companies were formerly far greater than are known at the present day. For instance, the Prairie Cattle Company's property, during its most prosperous days, amounted to 5,076,480 acres. In 1885 there were 220 cattle raisers in Texas who owned from 1,000 to 60,000 cattle. The control of such enormous areas of land as were required for maintaining the large herds was made possible through the old Mexican land grants in New Mexico, Colorado, and other parts of the Southwest, which varied in size from 10,000 to 1,000,000 acres.

The present method of managing cattle upon the range may be briefly described as follows: Each cattle raiser or company possesses an area of farming land upon which alfalfa and other forage crops and grain are raised for winter feeding. In connection with the ranch house are sheds and large corrals, and at convenient points upon the range branding corrals are constructed. Cattle are left for the most part to their own resources in securing forage, but as a rule are inspected by cowboys about once per month, and if they are found to be upon poor grass they are driven to more desirable locations. The cattle are counted on such tours of inspection, so that it may be known whether they are maintaining themselves in good condition and whether any cases of poisoning or other accidents have occurred. The territory over which range cattle travel varies in different parts of the country. The cattle which are maintained in central and northern Montana graze over the international boundary during summer and travel back or are brought back in time for the fall roundup.

Two general roundups are held during each year. The spring roundup takes place between April and June in different parts of the country. This roundup is for the purpose of counting the stock and branding the calves. Each calf is given the brand which is borne by its mother, and if any motherless calves are found they are branded as mavericks, with a special

mark belonging to the particular cattle raisers' association, and are subsequently sold to pay the expenses of the roundup and branding. It has been found necessary to establish cattle raisers' associations, in order to perform more effectively the various operations which are required by the range business. For example, where cattle may travel over a distance of 200 miles, it would evidently be altogether too expensive for an owner of a few cattle to travel over such immense areas for the purpose of locating his cattle. The brands of each owner are published and are well known, and each owner furnishes a number of cowboys for the general roundup, proportionate to the number of cattle which he owns. The calves belonging to the cows with their various brands are properly branded and the number reported to the owner who is charged a reasonable sum per head for this operation. The spring roundup and the branding of calves occupies considerable time on account of the fact that the cows must be carefully cut out of the herd, together with their calves, in order properly to establish ownership of the calves. The calves are usually held for branding by being roped and thrown upon the ground. The fall roundup, which usually takes place in September and October, is for the purpose of selecting animals suitable for beef. This roundup is also performed under the auspices of the cattle raisers' association for the given locality, and the animals selected for shipment are credited to their owners according to the brands which they bear.

In summer, range cattle seldom graze more than 5 to 10 miles from water. In winter they may travel rather longer distances for water. Cattle as a rule drink at noon and lie down near the watering place or rest in a standing position for a period of 2 or 3 hours before moving back to the grazing ground. In winter cattle are less capable of caring for themselves during severe snow storms than are sheep or horses. Cattle seldom learn how to paw the snow off of the ground and they are therefore forced during blizzards to "drift" in the direction of the storm. After the storm ceases they usually make their way back slowly.

Within recent years more and more attention has been given

to the selection of valuable bulls. As a rule the use of yearling bulls is not recommended, since their offspring is smaller and less vigorous than that of older bulls. It is usually recommended by cattle raisers that heifers should preferable have their first calf at three years of age . The proper proportion of bulls to cows varies in the opinion of different cattle raisers from 1 to 20, to 1 to 50. As already indicated the cost of running cattle upon the range without hay for winter feeding is from \$1.50 to \$2.50 per year, while the expense is considerably increased by feeding in winter, the cost under such circumstances varying from \$4 to \$10 per head. The annual increase of cattle under range conditions may be considered as being from 75 to 80 per cent. A certain percentage of cows are barren or abort, and a few calves are always lost by disease, accidents, snow storms, wild animals, etc.

The profits from the range cattle business, when properly managed, have always been and are still sufficiently great to tempt investment on the part of any one who understands the business sufficiently to avoid dangers. While, as will presently be shown, the range cattle business has yielded to sheep ranching, dairying, and farming and has several times been subject to great depression on account of unfavorable financial conditions, it is still an exceedingly prosperous business, especially in view of the present high prices of cattle. It is practically impossible at the present time to find large tracts of unoccupied range to which no other cattle or sheepman lays claim by right of previous grazing. At present new comers can best begin the business of cattle ranging by association with established companies and the gradual formation of a herd and selection of a portion of the company's range, or adjoining range, upon which to graze the animals.

It is desirable that the total number of beef animals in the United States be considerably increased, and this can be brought about to the greatest degree through the extension of irrigated agriculture in connection with cattle raising. The number of cattle which could be maintained under the old range conditions without raising winter feed was quite small in comparison with that which can ultimately be produced by the use of all avail-

able land for the production of forage crops, and the utilization of the adjoining range for maintaining stock in summer. Good descriptive accounts of the range industry in the days of the cattle kings are found in *Prairie Experience in Handling Cattle and Sheep*, 1885, by W. Shepherd; *Cattle Raising on the Plains of North America*, 1885, by Baron von Richthofen; *Historic Sketches of the Cattle Trade of the West and Southwest*, 1874, by J. G. McCoy; and *Report in regard to the Range and Ranch Business of the United States*, 1885, by Joseph Nimmo.

*Sheep raising.* Almost ideal conditions for raising sheep prevail over a large proportion of the western range country, and this fact has led to the gradual extension of sheep raising as an industry from the days of the early western settlers until the present time. As already indicated, the first sheep introduced into the southwestern part of the country were the Spanish Merino and the coarse wooled Mexican sheep. The Merino largely prevail at the present day on the ranges of Arizona and New Mexico, while the coarse wooled sheep which were first introduced into California and later crossed with Chinese rams have been replaced with other breeds obtained from Ohio, Missouri, and elsewhere.

As a rule the range which is at the disposal of each sheepman is so divided that a portion is used in summer and the remainder in winter. This arrangement has been found desirable, or in some instances necessary, for various reasons. An alternation of grazing and resting is made possible by this division into summer and winter range, and this has been found desirable in preventing the cumulative evil effects of overgrazing. The division into summer and winter range is also desirable from the standpoint of the sheep. Many ranges are available in winter on account of the presence of snow upon the ground, but could not be used in summer for the reason that there is no water supply. The summer range ordinarily lies at a greater altitude in the foothills or constitutes the mountain meadows of forest reserves and other timbered mountain areas. In such locations a sufficient water supply is found even during the driest seasons.

Sheep are driven to the summer range at different times in

different parts of the western country. In Arizona this may take place as early as April, while in Montana it is seldom done before July. The sheep are removed from the summer range and driven to winter range as soon as there is danger of the occurrence of fall snow storms in the mountains. Since these storms appear at different seasons according to the latitude and altitude, the period varies from September to November.

It is customary to have the lambing season fall at a period in the spring when green grass may be reasonably expected for grazing, and after danger of spring snow storms has passed. The lambing season in Montana occupies the month of May, and this is ordinarily safe, although in some years, as for example in 1903, great losses in lambs occurred from May snow storms. During the lambing season an extra number of herders are put in charge of each ewe band, so as to remove the ewes and their lambs are placed in this wagon and hauled to the lambing sheds. After about 10 days the small lambing bands are brought together into herds of 2,500 to 3,000, and the lambs are then ready for docking, marking, and castrating. These operations are performed with great rapidity by expert operators who have charge of this work. The percentage of lambs saved varies considerably with different years and different sheepman. The variation may be from 50 to 100 per cent. As a rule, however, extreme losses are due to unfortunate conditions or inexperience. About 80 per cent of lambs may be considered as the ordinary degree of success under range conditions.

The time of shearing also differs according to climatic and other conditions. It is much earlier in the southern States, where sheep are sheared twice annually, and is latest in Montana, where sheep are sheared during June and July. Shearing in the western States is done by professional shearers who work in Australia and South America during our winter season, and begin shearing in Texas and New Mexico early in the spring, after which they gradually proceed northward until the shearing season closes in Montana. An average of from 90 to 120 sheep is considered a fair day's work for a shearer. As high as 250 sheep, however, have been sheared in a single day by one man. During recent years the establishment of plants

for machine shearing has progressed rapidly and the objections which were first raised by shearers and sheep raisers have been largely overcome. Sheep are not sheared any faster by machine than by hand, but the work is done more smoothly, with less injury to the sheep and a slightly heavier fleece is obtained. Some sheep raisers who have had wide experience with both methods of shearing claim that they obtain 1 lb. of wool per sheep more by machine shearing than by hand work.

The problem of securing a good water supply for sheep on the range is as important as it is in the case of cattle. In the northwestern States sheep require water frequently, at least once per day, while in parts of New Mexico and Arizona where sheep graze upon succulent plants in the hot dry summer months, they may be maintained for from 50 to 60 days without water. Wherever sheep require water daily it is obviously necessary to have watering places distributed at short intervals. Wherever the water cannot be easily obtained by the sheep without trampling the mud and polluting the spring or stream, it is highly desirable that the water be piped into troughs from which the sheep may obtain it more conveniently.

Wherever salt is not found in the natural alkali which prevails over large areas of the western range this substance should be supplied in large chunks to which sheep may have constant access. The poisonous effects which have been attributed to alkali in some parts of the country may well be due to eating large quantities of common alkalies, such as carbonate of soda, epsom salts, etc.

The breeds of sheep which were formerly preferred were such as would produce the best wool or mutton type. For this purpose pure breeds, either fine or coarse wooled according to the product which the raiser wished to secure, were selected. During recent years, with the rapid development of the sheep industry, it has been found desirable to secure a general purpose sheep which combines so far as possible the power of producing a good fleece and a desirable mutton form. In order to bring about the proper grade for this purpose it has been found desirable to cross a good race of Merino, such as Rambouillet or Delaine, with a coarse-wooled sheep and to maintain bands of

coarse-wooled and fine-wooled bucks in order to check a tendency in the direction of too great fineness or coarseness of wool. A general purpose sheep such as just described has been found in crosses between Merinos and Cotswolds or Lincolns and is considered to be the most successful and profitable animal to raise.

The bucks are maintained in separate bands of different sizes, depending upon the number of sheep owned by different sheep raisers, and are kept in the care of a herder upon the range. They are turned with the ewes during the month of December in Montana and Wyoming and at other dates in other parts of the country, according to the desired lambing period.

As with cattle ranging, so with sheep grazing, in the early days little attention was paid to the construction of sheds or corrals. Recently, however, it has been found to be good economy to build extensive lambing sheds in which the ewes and their lambs may be protected during inclement weather, and the construction of feeding corrals and shearing sheds has become necessary with the great development of the sheep business. The lambing and shearing sheds are usually of large size so as to accommodate the large number of sheep which are owned by each sheep raiser. It has therefore become necessary for the enterprising sheep raiser to invest considerable money in the construction of a plant for carrying on his business.

As already indicated little or no heed was given to the subject of winter feeding until within comparatively recent years. It was soon found that winter range could be selected where the snow fall was so exceedingly light and where the sheep could maintain themselves during the whole winter without artificial feeding, with but very slight loss. Years of drought, heavy snow falls, severe winters, and overgrazing of the range, however, made it apparent to the more progressive sheep raiser that winter feeding must be done if the sheep business were to be carried on without unnecessary risk. Wherever, as for example in Montana, alfalfa can be produced, harvested, and stacked for a cost of from 75 cents to \$1.25 per ton it is evidently a good business proposition to produce this forage for feeding sheep in order to avoid losses in winter and to increase greatly

the gains in weight. Hay used for winter feeding is of various sorts, according to the location of the sheep ranch. In some localities alfalfa, clover, timothy, brome grass and other cultivated forage crops are raised for winter feeding, while in other localities less energy is expended upon this side of the business, and native forage such as bluejoint, bunch grasses, or lupines and other native leguminous plants are cut for hay. Sheep which are not intended for market but merely for stock purposes do not require forcing during the winter but are fed merely enough to keep them in good condition. In favorable years it is not necessary to feed more than from 2 to 4 weeks during the winter, even on the northern Montana ranges. The amount of hay required, therefore, is very small and a sufficient quantity can be raised on a comparatively small area.

The feeding habits of sheep differ greatly under different conditions. Sheep eat a great variety of plants, including all of the native and cultivated grasses, various leguminous plants, sedges, lupines, false lupines, wild licorice, geraniums, sage brush, saltbushes, etc. On some winter ranges, as for example in the Red Desert of Wyoming, sage brush is a very important forage plant and is really eaten by the sheep. In addition to grass and weeds sheep feed upon leaves and small twigs of various trees, including willow, poplar, oak, pine, juniper, etc. The latter, two trees, however, are only eaten under stress of hunger.

With regard to the effects of sheep grazing upon the range, it may be said that this matter depends largely upon the method of management of the sheep. As a general proposition it may be asserted that the less the sheep are interfered with the less injury they do to the range. When the sheep are allowed to graze in open formation the individuals of the band are better able to secure forage and the range is not trampled to the same extent as when the bands are harassed by dogs so as to keep them in a compact formation. Under the latter conditions the grass is trampled down and destroyed, the roots injured, and the ground cut up. The grazing of sheep under a rational management is not necessarily destructive to the range, but it is unfortunately true that great damage can be done to grass and to seed-

ling trees by overcrowding the range with sheep, by keeping them too long in one location, and by driving them in large bands huddled closely together. Thus in California in 1863 James E. Perkins\* found that "The native grasses of California are with rare exceptions annuals, propagated each year from the seeds scattered the preceding year. Where the lands have been so persistently overstocked the herbage has necessarily become thinner and thinner as the seeds have been gradually destroyed. This process of depasturage, though not confined to any one species of herbage, is most strikingly exhibited in the great oat ranges, where, less than ten years ago, the traveler would ride for days through wild oats tall enough to tie across his saddle, now dwindled down to a stunted growth of six to ten inches, with wide reaches of utterly barren land, marking the extinction of the native growth."

In the problem of sheep grazing the tramp sheepman plays a very important part and is everywhere recognized as one of the chief causes of injury to the range. The tramp sheepman introduces a factor of overcrowding which cannot be regulated by the local sheepman for the reason that the time of coming and the number of tramp sheep cannot be foretold for any particular season. The advent of tramp sheep to a range which has previously been preserved through the efforts of local stock raisers always leads to excessive grazing and to bitter feelings and manifestations of violence between contending parties. Wherever the tramp sheep nuisance does not exist the solution of the sheep grazing problem would seem to lie in a proper division of the grazing area into summer and winter range so as to allow all parts of the range a sufficient period during each year for recovering from the effects of grazing.

The cost of managing sheep under range conditions varies within quite wide limits. Where no winter feeding is done and where the buildings are of the cheaper sort it is possible to manage sheep at a cost of 25 cents per head per year. The cost is considerably increased where more extensive plants are maintained and where the animals are fed in winter. Under the latter circumstances it has been found that the cost of managing

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\* Sheep Husbandry in California, 1863, pp. 9, 13.

sheep varies from 75 cents to \$1.25 per head per year. Since the average clip of wool throughout the United States is 6 lb. per sheep, and somewhat higher in the western States, and since the sheep raiser may reasonably expect about 80 per cent of lambs, it is apparent that large profits may be expected from sheep grazing under average conditions. Some sheepmen make a profit of as much as \$1.50 per head for the total number of sheep which they own. The large profits to be realized from this business are apparent when one considers the wholesale manner in which sheep are raised upon the range. A large proportion of sheep raisers of the range States own from 10,000 to 75,000 sheep, which are maintained in bands of from 2,000 to 3,000 under the constant care of 1 or 2 herders, according to the grazing conditions. While great losses may occur from time to time from heavy snow storms, poisonous plants, and other causes, these dangers may be largely avoided by the exercise of proper precautions, and when such precautions are taken the profits of sheep ranching are perhaps as great as in any other legitimate business.\*

*Other livestock.* As with cattle and sheep, so with horses, the first to be introduced into the Southwest came through the agency of the Spaniards and were gradually distributed among the settlements and missions in this part of the country. The horses which were first used in Southwest were of a small breed, commonly known as the mustang, many of which escaped from the settlements and served as the basis for the formation of extensive herds of wild horses which have ranged over a large portion of the arid plains until the present time. The wild horses in southern California, New Mexico, and Arizona proved to be a veritable nuisance, since they occurred in such numbers as to destroy the grass and thus interfered with the raising of more valuable horses and other stock. In fact, in certain parts of the country no attempt was made in the early days to raise higher grade horses, since a sufficient number of horses fairly suitable for saddle purposes could be obtained by

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\* For general accounts of the range sheep industry consult Special Report on the History and Present Condition of the Sheep Industry of the United States, Bureau of Animal Industry, 1892; Bureau of Animal Industry Reports for 1900, p. 91; 1902, p. 79.

catching and breaking wild horses. The Indians became expert at this business and replenished their exhausted herds in this way. With the advent of settlers many horses of better breed escaped upon the plains in various localities or were stampeded by the Indians, and these admixtures served to some extent in modifying the character of the wild or semiwild horses of the plains. Various names, such as cayuse, bronco, mustang, and Indian pony, have been applied at different times and in different localities to what is essentially one race of horses. The term cayuse was originally applied to the horses which were possessed by the Cayuse Indians of eastern Oregon. The western bronco was too small for draft purposes, but before the introduction of railroads freight was transported largely by ox teams and no special need was felt for the breeding of draft horses in the western States. The horse business suffered severe depressions at several times, and these business depressions together with the low value of the common bronco led to the introduction of improved breeds in order to increase the value of the range horses. At present the desirability of using improved stallions, such as Percheron, English Draft or Clydesdale, for the production of draft horses, and thoroughbreds, hackneys, etc., for breeding road and saddle horses, is very keenly felt. The general reputation of range horses for the possession of a vicious character almost excluded these animals from the market, or at least prevented owners from obtaining a price which would justify raising that class of horse. They are, however, possessed of great endurance and for that reason have been used quite extensively for saddle purposes and have been bought in large numbers for the English army. The demand created by the British for these horses during the South Africa war increased the prices of range horses in some localities from \$15 to \$40 per head, and greatly stimulated the range horse industry. The future of this industry, however, must naturally lie in the direction of an improvement of the disposition and form of the range horse, while his great strength and endurance are retained.

The presence importance of the horse industry in the arid

States is indicated by the fact that about 3,542,000 horses are reported from these States by the census of 1900.

The teeth of the horse are admirably adapted to grazing and they are capable of grazing more closely than cattle. Serious injury to the range from grazing by horses, however, rarely takes place under normal conditions where the grazing area is not overcrowded. Horses are better capable of maintaining themselves in severe snow storms in winter than any other stock. They readily gain access to the grass by pawing away the snow, and for this reason the herds of range horses are sometimes followed by cattle during severe storms.

While the mule is everywhere recognized as a desirable draft animal, possessing a number of advantages over the horse, the raising of these animals has thus far been confined largely to the corn, cotton, and sugar producing areas. In the arid States mules have served chiefly as pack animals and for mining operations. In the mines the mule exhibits certain advantages over the horse. When startled he does not throw the head upwards like the horse, and is therefore not injured by bruising the head against the ceiling of mining tunnels. As a pack animal the mule is capable of carrying larger burdens than the horse and is less likely to become exhausted when traveling across comparatively barren areas. The mule enjoys comparative immunity from disease, lives to a great age, and can endure greater hardship than the horse. The experience of breeders has shown that the mule can maintain itself in good condition on less and poorer feed than is required for the horse. In the southern States mules are classified into sugar mules, which are the larger animals, and cotton mules, which are somewhat smaller in size. In the arid States these distinctions are not usually recognized.

The mare to be used in the breeding of mules must be sound, of good constitution and form, and should preferably be of a black, brown, bay, or chestnut color, although in some localities a gray color is not objectionable in mules. The colts are weaned at about 4 month of age, and are then fed upon soft grain and hay or grass for a considerable period. The number of mules in the arid States, according to the latest census, is 629,000.

The breeds of jacks commonly used for the production of mules are Andalusian, Catalonian, Maltese, Italian, Majorca, and native. Each of these breeds possesses good points which cause it to be preferred by different breeders, but in recent years the native jack has demonstrated certain points of superiority over all other breeds. The native is a mixture of the various pure breeds which have been introduced into this country.

In the mountainous regions of the western States the burro has been known since the earliest Spanish occupation of the country, and has been used from that time until the present as a pack animal. The burro is apparently a small race of jacks of Spanish origin. White is a very frequent color in these animals, and another characteristic sometimes developed to a striking degree, is the width of the base of the neck. The burro, although a very small animal and of slow gait, is capable of carrying unusually heavy burdens along rough mountain trails where the horse would be less suitable. The number of asses and burros in the arid States, according to the census of 1900, is about 52,000.

The goat industry has rapidly increased throughout the United States during the past few years, in consequence of the discovery of the great possibilities of goat raising on mountainous and comparatively barren areas which might otherwise be of no economic value. The number of goats in the arid States, according to the latest census, is about 1,172,000. A considerable proportion of these are Angora, and of course the pure Angora or grade is of much greater value than the common goat. Goats have been found to be excellent animals for clearing up brush lands and destroying briars and weeds. In some locations they appear to prefer the leaves and small twigs of bushes and other rough forage to grass. While this characteristic of goats is of great value where one wishes to clear up brush lands, it at the same time renders these animals objectionable in forest reserves, except when kept under careful supervision. Aside from their more pronounced tendency to eat brush, goats have essentially the same feeding habits as sheep, and when raised on a large scale are managed in practically the same manner as sheep. Goats are probably less susceptible to

disease than sheep, but great losses have been recently experienced from attempting to graze goats on lands infested with lung and stomach worms, and also from the attack of a new disease known as takosis and investigated by Dr. J. R. Mohler.\* The requirements of goats with regard to water and salt are essentially the same as those of sheep. Goats travel more rapidly and over greater distances while grazing than do sheep. For this reason, and also for the reason that the younger are rather delicate during the first few weeks, it is necessary at first to keep the kids in corrals or sheds during the day time. They are unable to travel as far as the does and are very sensitive to cold or rains.

*The relative increase and decrease in sheep and cattle raising.* Except in the Southwest the range cattle business was developed before sheep ranching. At the present time the sheep industry of the range country is steadily increasing, while the range cattle industry is at a stand still or on the decline. The following table, compiled partly from data collected by G. F. Thompson, will serve to illustrate the ups and downs of the cattle and sheep business from 1880 until 1900.

TABLE SHOWING VARIATION IN NUMBER OF SHEEP AND CATTLE FROM 1880 TO 1900.

	1880	1890	1895	1900
<b>New Mexico:</b>				
Cattle .....	334,981	1,341,856	793,506	472,219
Sheep .....	3,938,831	3,123,663	2,738,030	4,899,487
<b>Arizona:</b>				
Cattle .....	126,601	725,004	636,512	366,951
Sheep .....	406,524	800,000	746,546	924,761
<b>Nevada:</b>				
Cattle .....	203,504	317,498	259,078	218,198
Sheep .....	230,695	504,710	544,077	887,039
<b>Montana:</b>				
Cattle .....	416,971	932,697	1,153,557	611,838
Sheep .....	250,000	1,555,116	3,061,502	6,170,483
<b>Wyoming:</b>				
Cattle .....	517,483	1,096,101	751,849	424,153
Sheep .....	450,225	1,119,110	1,393,693	5,099,613
<b>Colorado:</b>				
Cattle .....	762,722	1,017,465	926,560	850,163
Sheep .....	1,091,443	1,819,569	1,319,049	2,044,814
<b>Total:</b>				
Cattle .....	2,362,272	5,430,521	4,521,062	2,943,522
Sheep .....	6,367,718	8,922,168	9,802,897	20,016,197

\*Bur. Animal Industry, Bul. 45.

The States and territories included in this table were selected from various parts of the range country, two of them being in the Southwest, one in the Great Basin, and three in the Rocky Mountain region. An examination of the data obtained from a study of these conditions in other States showed exactly the same tendencies. Selection was made for the purpose of exhibiting the conditions in different parts of the country, at the same time avoiding a too large and complicated table. It will be seen at once by an examination of this table that the number of sheep in each State and territory increased with considerable regularity from 1880 until 1900. The same tendency was shown before 1880, but the data previous to this date are not complete for range sheep and cattle. The number of cattle, on the other hand, increased quite rapidly up to 1885 or 1890, since which time it has fallen off to a greater or less degree in every State and Territory of the arid region. In some instances the rapid increase in the number of sheep and simultaneous decrease in the number of cattle is exceedingly marked; for instance, in Wyoming there are at present about one third as many cattle as in 1890, while the number of sheep has increased five times. When the total number of sheep for the seven States and territories included in the table are compared with the total number of cattle, it is seen that the ratio of cattle to sheep was 1 to 3 in 1880, 5 to 8 in 1890, 4 to 9 in 1895, and 5 to 20 in 1900.

The present high prices of beef have stimulated to a considerable extent the production of range cattle and the numbers of such animals in several of the western States, especially in the Rocky Mountain region, have increased considerably since 1900. Taken as a whole, however, statistics show conclusively that the range cattle business is gradually yielding to the encroachment of sheep ranching. The causes of this tendency are naturally varied and it would be presumptuous in a short discussion to attempt to do more than merely hint at them. While the sheep business suffered great depressions during the period when wool was cheap, it appeared to recover completely and rapidly within a short period after better prices were ob-

tained for wool and the numbers of sheep have gone beyond any which had previously been reached.

The relative profits to be made from the sheep and cattle industries naturally constitute an important factor in determining their relative degree of extension. There are other factors, however, which have been operative from time to time in determining this matter. It has been found by experience that the open range is, in many localities at least, better adapted to the sheep business than to the raising of cattle. Sheep have to be maintained in bands under the care of herders, and they can therefore be moved from place to place as occasion requires, in order to secure better grazing. The sheepman is therefore in a position to secure the best grass upon the range, and thereby make it difficult for the cattleman to keep his cattle in good condition. It should also be remembered that sheep can readily be maintained in the mountain pastures in summer where cattle will not stay on account of the attacks of flies. As a rule, moreover, the grazing of sheep and cattle on the same range is practically impossible on account of the fact that cattle manifest a dislike for grass which has been grazed by sheep and which retains the odor of these animals. In open competition for the range, therefore, it appears that the sheepman has a distinct advantage over the cattleman, and this fact is being forced home upon the cattleman from year to year. Many men who have been engaged in the cattle business for a long period of years have found themselves gradually surrounded by sheep, and have finally been forced to sell their cattle to engage in the sheep business out of selfprotection. Instances of this kind are to be met with almost anywhere throughout the range country and in conversing with cattlemen one often hears the remark that this tendency will continue in force until a considerable proportion of what was once cattle range will be devoted to sheep grazing. As an example of the rapid change in this direction we may mention the Big Horn Basin, which years ago was occupied almost exclusively by cattle, and which has now been given over almost entirely to sheep.

The controversy between the sheepman and cattleman must also be considered in discussing this question. In fact there

have been and still are serious controversies with manifestations of violence between sheepmen and cattlemen, and also between homesteaders and cattlemen. These controversies have been largely the result of attempts to monopolize the public range. Long before the emigration of the American settler into the western States the Indians had learned to misrepresent the conditions which prevailed in different parts of the western country. If a traveler indicated a desire to visit a fertile portion of the country, he was told that the region was a barren desert incapable of supporting human or animal life. If, on other hand, the traveler intended to visit some region which the Indian knew to be of a desert nature, he was given glowing tales of the fertility of the region and was urged to proceed on his journey. Thus, even in 1535, Cabeza de Vaca<sup>1</sup> was advised by the Indians not to go into the interior of the Arkansas country, they falsely declaring that it was desert and barren. Marcy<sup>2</sup> had the same experience along the Red River in 1852. "They (the Indians) told us that the entire country was a perfectly desolate waste . . . . Their statements have proved false in every particular . . . . as we have thus far found an abundance of the most nutritious grasses." The motives which actuated the Indians in making such false reports are also apparent in the statements which are often made by large cattlemen to prospective settlers. Von Richthofen<sup>3</sup> says that the cattle kings tried to perpetuate the idea that the plains were a desert in order to keep out settlers. Smalley<sup>4</sup> makes the following reference to this subject: "Self interest naturally leads the present occupants of the territory to discourage the bringing in of more cattle. They wish to preserve ample room for the increase of their herds."

The means which were used for discouraging settlers from locating varied according to the disposition of the cattlemen who were already occupying the free range. In some instances violence was threatened or used at once; in other instances a

<sup>1</sup> Loc. cit., p. 97.

<sup>2</sup> Loc. cit., p. 31.

<sup>3</sup> Cattle Raising on the Plains of North America, 1885, p. 10.

<sup>4</sup> Report on the Range and Ranch Cattle Business of the United States, 1885, p. 84.

more diplomatic means of discouragement was employed. As an example of the notices which were frequently posted in conspicuous places to warn settlers or other stock-raisers from locating upon range already occupied we may reproduce a notice which was posted for the purpose of keeping settlers and stockmen from the Musselshell range in Montana, which occupied an area of nearly 4,000,000 acres. After defining the boundaries of the range, the notice contains the following statement: "We, the undersigned, stock growers of the above described range, hereby give notice that we consider said range already overstocked; therefore we positively decline allowing any outside parties, or any parties locating herds upon this range, the use of our corrals, nor will they be permitted to join us in any round-up on said range from and after this date." Curious inconsistencies on this point are sometimes observed in the literature of the range cattle business. For example, H. M. Taylor\* states that "with rare exceptions, the talk of herd owners 'bulldozing' or driving out would be settlers and farmers is pure fiction . . . . There is really no antagonism between the grazing and the farming industries of the West because there cannot be, according to the nature of the country, any conflict." On page 315 of the same article, however, we observe the following statement: "No man seeking a homestead would have the courage to attempt to secure a home within the limits of any of the princely possession enjoyed by the large lease-holders. The law might give him the right, but the proscription and persecution that might be practiced by the strong arm in possession would nullify the privileges extended by the law—would defeat every effort and drive the small owner from the range." Threats, accompanied or not with violence, are made at the present day, as is evidenced by the numerous newspaper accounts concerning conflicts over the range. These conflicts naturally exercise some influence in determining the relative importance of cattle raising, sheep raising, and farming in various parts of the range country.

Range management. The method of managing the public

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\* U. S. Dept. Agr. Bureau of Animal Industry Rpt. 1885, p. 294.

range proposed by Wooldridge\* is encumbered with numerous, serious objections. Mr. Wooldridge recommends that annual grazing licenses be issued to local cooperative cattle and sheep associations which should thus have control of the management of the range. In all of the arid public land, States, cattle associations have been formed for the better management of the business of cattle raising and the prevention of stock thefts and other nuisances. It is difficult to understand, however, in what status the public domain would be found when controlled by a cooperative association under a "license." From a legal standpoint, the control of land under a license based neither on sale nor lease would be to say the least very anomalous and almost undefinable. The most serious objection to this plan, however, is that the control of the land would thereby be removed from the Federal Government with no assurance whatever that the grazing land would be managed in accordance with the best interests of the community. As already shown by the example of the Musselshell cattlemen, such associations are exceedingly prone to appropriate the land for themselves and to try by all means, legitimate and otherwise, to prevent the free use of the range by other individuals who may be located conveniently near. The tendency to form cliques to the exclusion of new comers and small owners is and has been one of the most conspicuous features of all such movements. It is, therefore, believed that the only safe way of controlling the utilization of the public range is by a system of legal leasing according to which the land still remains under the immediate supervision of the Federal Government. By this method, all persons would have an equal opportunity to lease land whether they had large or small numbers of cattle or sheep as the case might be. The Federal Government would also be in a position to refuse a renewal of the lease to all parties who violate the provisions of such lease or who unnecessarily damage the grazing lands. . .

Among the many devices which have been employed for controlling the range and preventing new comers from securing a location, special mention should be made of fencing and purchase of scrip. The scrip may be and frequently is purchased so

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\* Out West for November 1903, p. 560.

as to cover narrow strips of land along either border of streams. The purchaser of the scrip thus without any extra cost obtains control of immense tracts of country lying between streams. This grazing land between the streams is of no use to other stockmen, unless they can obtain access to water, and this is usually prevented by the purchasers of scrip as just indicated. In other instances where large basins containing excellent grazing lands are connected with basins lying farther down the stream by a narrow canon, scrip is bought in the canon ; it is thus possible for the stockman at a slight cost to gain control of large grazing areas, since other men cannot enter the basin without passing over land of the scrip purchaser, and such trespassing he is of course very careful to prevent. The present system according to which the public land and railroad land is arranged in alternate sections permits evident abuse on the part of stockmen who lease the railroad land. By leasing railroad sections and fencing them, it is possible to surround sections of public land and prevent any one else from gaining access to them. The public land is thus secured without any cost.

*Future of the range industry.* Attention has already been called to the fact that the utilization of the public range was at first confined largely to the establishment and maintenance of immense herds of cattle and sheep. In some parts of the range country control of the grazing land was made possible through Mexican land grants and through leasing railroad and State lands so as to surround government lands. The present tendency, however, is decidedly in the direction of smaller subdivisions of the range, thus increasing the number of persons interested in stock raising and also the number of animals. Occasionally it is asserted that the present tendency is in the opposite direction, viz., toward the further consolidation of range interests and holdings and the establishment of even larger cattle and sheep companies than now exist. We believe, however, that this is a mistaken notion. In connection with arguments to the effect that large companies are gradually displacing small owners it is sometimes asserted that this alleged tendency toward large holdings is of recent origin. Joseph Nimmo\* states that "The

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\* Loc. cit., p. 39.

public sentiment of this country is and always has been strongly opposed to the disposition of the public lands in large quantities, either to one person or to corporations. The genius of our institutions is in favor of comparatively small holdings, and the result of practical experience under this policy since the first settlement by colonists upon our shores has caused it to become a cherished feature of our method of disposing of the public lands." As a matter of history, the exact reverse of this proposition is true. Alexander Hamilton, who proposed the first plan for the disposition of public lands, recommended that the public lands be sold in any quantities, to individuals or corporations, and that special attention be given to arranging the plan so that the sale of lands in large tracts would be rendered easy. It was suggested by Hamilton that the wishes of capitalists should be considered before those of actual settlers, on account of the need of funds at that time. The history of the various plans for the disposal of the public lands shows plainly the gradual evolution of the idea of disposing of these lands in small quantities to actual settlers. This idea, however, did not take firm root until comparatively recent times.

The irrigable land is rapidly being taken up for settlement, and the area available for grazing is therefore decreasing from year to year. Since each homesteader may, and usually does raise a number of cattle or sheep which graze on the land adjacent to his homestead, it is apparent that the open public range is being rapidly curtailed and does not compare in extent with the areas available for grazing in the days of the cattle kings.

The greater proportion, however, can probably never be irrigated, and its only utilization where dry farming is impossible must be for grazing of stock. The future of the range industry therefore appears to lie in the direction of the extension of irrigation and consequent increase in the quantity of forage crops raised, and a corresponding increase in the number of live stock in the range States. It is a selfevident proposition that the more cultivated crops are raised for feeding, the larger the number of animals which can be supported on the range, since they will not depend so completely upon the range for maintenance.

The unlimited ranging of either cattle or sheep is incompatible with the best interests of the homesteader and farmer and is therefore opposed to the development of the western country. Holdings must therefore in the future become smaller in extent. As soon as these facts are recognized it will become apparent to all concerned that the best interests of the cattleman and sheepman are not opposed to those of the farmer. The range industry will be brought into greater and greater dependence upon the production of forage crops by the farmer, and the greatest possible utilization can thus be brought about, both of irrigable land and also of the non-irrigable range country.



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